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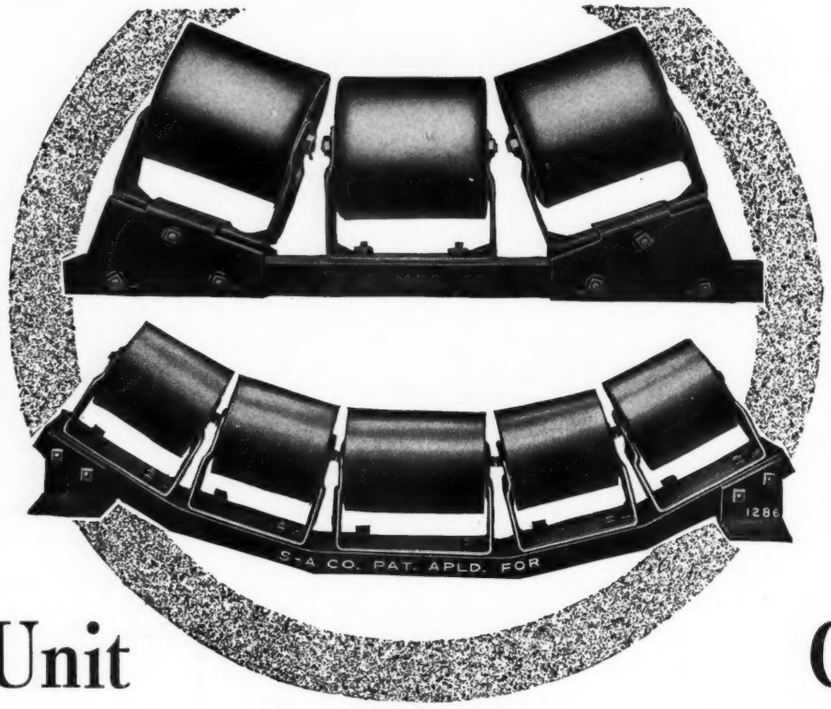

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Engineering and Mining Journal

VOLUME 102 DECEMBER 16, 1916 NUMBER 25

The Big Pine Cyanide Mill

By C. H. Dunning*

SYNOPSIS—An 80-ton cyanide plant in Arizona obtains an extraction of 90% with milling costs of $1.37 per ton. The plant has several interesting features, among which are the method of starting the tube mills, the natural counter-current pulp and solution flow, and the absence of agitators due to the granular character of the ore.

The Big Pine Consolidated Mining Co. has recently completed the installation of an interesting cyanide plant at its mine 12 mi. south of Prescott, Ariz.

The ore occurs in a mineralized fault fracture in quartz diorite and consists of fragments of altered quartz diorite of variable size cemented together by quartz carrying gold, silver and iron, with a very little lead and no copper or zinc. The oxidation extends in most places to 500 ft. in depth, and of the 70,000 tons the company has developed, about 50,000 is oxidized ore. The ore in the mine averages $9.50 per ton, and it is expected that the mill heads will average at least $8 per ton. The mine is exceptionally well situated for economical operation, and the ore is being delivered to the mill at a cost of about $1.25 per ton.

The ore is run out of the tunnel by hand to the mill and is dumped upon a grizzly with 1½-in. openings in the usual manner. Just before dumping the trammer adds about 2 lb. of lime to each ton car. The oversize from the grizzly is shoveled into a 9x15-in. Blake crusher set to crush to 1½ in. The man at the crusher sorts out all very hard pieces of ore, which he throws into a special chute to be used for tube-mill pebbles.

The bin is rectangular and holds about 400 tons. It has a flat bottom and is set on posts with the bottom 7 ft. from the ground. Two plunger feeders in the bottom discharge upon a 12-in. conveyor running lengthwise under the bin. This in turn discharges upon another conveyor at right angles, which carries the ore to a set of 14x27-in. Colorado Iron Works rolls. This roll is only a temporary installation and is doing over duty in crushing from 1½ in. to about ¼ in. It will be replaced later by a ball mill.

The rolls discharge upon a short conveyor which carries the ore to the box in which the tube-mill scoop operates. Cyanide solution of 2 lb. strength is introduced at this point. The tube mill is 5x22 ft. and runs at 28 r.p.m. It is operated by a 100-hp. three-phase 220-volt motor. The motor is rigged with a reversing switch so that throwing the switch in one direction will drive the mill one way, while throwing it the other way will reverse the direction of the mill. This is a very simple electrical device and has been found to be of great assistance in starting the mill. The switch is first thrown in one direction and the starting lever thrown over on the starting side. This will drag the mill around for a few feet to a point where it will stop. The starting lever is then thrown out and the switch quickly reversed and the lever thrown in again. For a moment the load in the mill is working with the

FIG. 1. THE CAMP AND MILL OF THE BIG PINE CONSOLIDATED MINING CO.

*Manager, Big Pine Consolidated Mining Co., Prescott, Ariz.

motor and considerable additional momentum is obtained on the back swing. After two or three reversals of the switch a complete revolution is obtained, the mill picks up speed and the starting is completed. I can strongly recommend this simple little device to anyone having trouble in starting tube mills.

Hard mine ore is largely used for tube mill pebbles. Rounded pebbles of hard blue diorite from a local creek are also used when the mine ore cannot be obtained in sufficient quantity. About three tons per day is necessary, and the loading is done through the door.

The discharge from the tube mill is maintained at about 40% moisture and goes through an 8x54-in. Frenier pump to a 45-in. Akins classifier. The classifier separates at about 100-mesh, the sands dropping directly into the tube-mill feed box and the slimes going by gravity to the No. 1 Dorr thickener on the next floor. An extraction of about 75% is obtained up to this point. The No. 1 thickener is 30x11 ft. The overflow runs into the gold-solution storage tank. No clarifying tank has been found necessary. The storage tank is connected to the suction of a Dean triplex solution pump, zinc dust being fed in between. The pump forces the pregnant solution through a Merrill press, which is set on top of the barren-solution storage tank and drains directly into it. This tank is set on trusses directly over the tube mill, and it has been found advantageous at times to have it inside of the building. The thick pulp at 50% moisture is lifted by a 4-in. diaphragm pump into agitator No. 1. The

An interesting feature of one of these agitator-thickener sets is the natural counter-current flow of pulp and solution theoretically possible. This is due to the fact that the pulp in the agitator above the discharge point is of a much higher specific gravity than in the thickener above the same point. Referring to Fig. 3 the pulp in thickener No. 1 flows by gravity to agitator No. 1 until it reaches the level *A*, which is the level of the pulp in thickener No. 1. In the agitator an even dilution of 3 to 1 is maintained throughout the tank. The pulp flows through the discharge pipe *B* to the thickener No. 1. *B* is placed at approximately the bottom of the clear-solution level and goes to the center of the thickener so as not to spoil the efficiency of the settling. Therefore in the outside

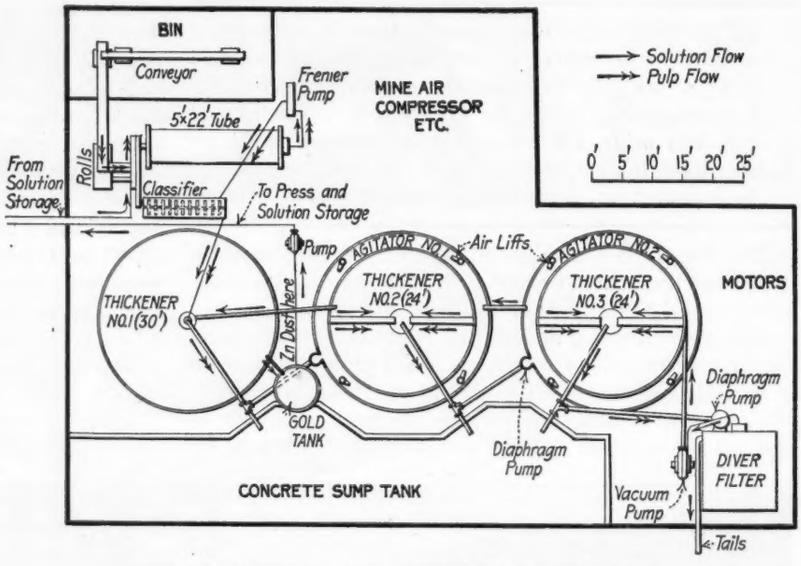

FIG. 2. GENERAL ARRANGEMENT OF THE MILL

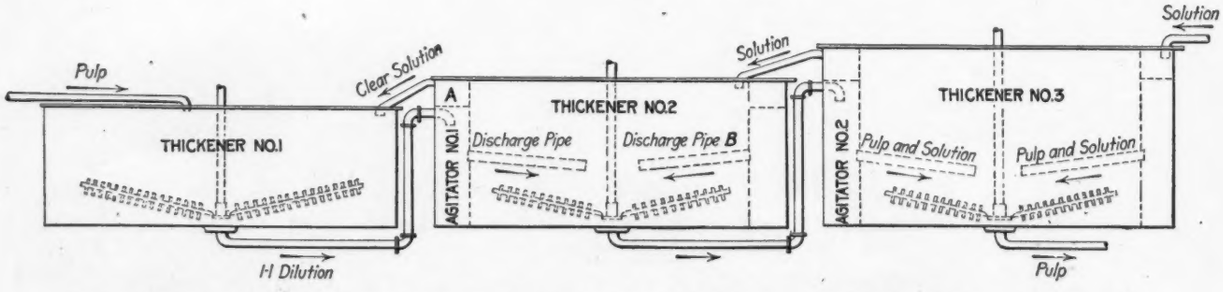

FIG. 3. THE AGITATOR-THICKENER SETS, SHOWING THEORETICAL COUNTER-CURRENT PULP AND SOLUTION FLOW

agitators are of a modified Parral type, the invention of D. H. Bradley, Jr., and I believe this is the first installation of the kind.

They consist of an annular tank 3 ft. wide surrounding a 24-ft. Dorr thickener. In it are arranged at equidistant points four 6-in. air lifts which pick up the pulp at the bottom and discharge it just below the surface with considerable force, so as to give the mass a swirling motion. The air lifts are set at the outer edge of the tank and discharge tangent to the inner edge in order to take care of any tendency toward an accumulation of heavier particles near the outside. Two 4-in. pipes carry the discharge from the agitator to the center of the inside thickener, just below the clear solution level. The agitator is fed continuously, and discharges continuously to the thickener. agitator above the pipe *B* we have a 3 to 1 pulp, while in the inside thickener above this same point we have nearly a clear solution, and the difference in specific gravity forces the solution in the inside thickener to a level about 16 in. higher than in the outside agitator, where it flows by gravity back to No. 1 thickener. The same applies to the next set and so on, so that by adding pulp at one end of the system and solution at the other both will flow by gravity in opposite directions.

This has not been attempted in practice, however, on account of the fact that the pulp is often so sticky and thick that it would clog the pipes. It is assisted out of each thickener by a diaphragm pump. A Marsh 14x12-in. air compressor running at 80 r.p.m. and consuming about 10 hp. supplies sufficient air at 7 lb. pressure for the eight

air lifts in the two agitators. A blower would no doubt be a more economical method of obtaining the air, as this compressor is not designed for that kind of work.

In No. 1 agitator the thick pulp is diluted to 3 to 1 by the clear overflow from No. 3 thickener. No cyanide is added after this agitator, the remainder of the plant being merely for washing purposes. The thick pulp from No. 2 thickener goes to No. 2 agitator, where it is diluted by the solution from the filter vacuum pump.

The pulp from No. 3 thickener goes to a 9x11-ft. Oliver filter. The solution and wash from the filter are drawn

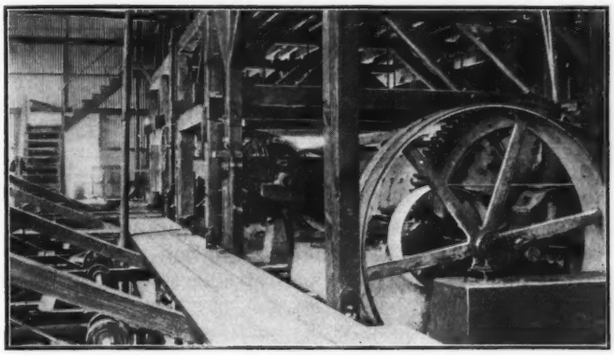

FIG. 4. TUBE MILL AND RUNWAY

through the vacuum pump and discharged to No. 2 agitator. The tailings are discharged upon a conveyor belt. An extraction of over 90% is being obtained.

The ore does not make a true slime, but rather a fine granular product that settles readily. Furthermore, it was found unnecessary to grind very fine, and the result-

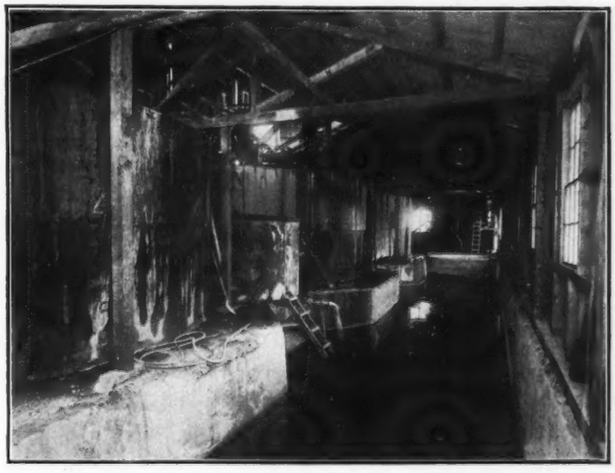

FIG. 5. AGITATOR-THICKENER SETS AND SUMP

ing comparatively coarse product gave considerable trouble in the agitators by settling between the air lifts Since an exceptionally high extraction was obtained in the tube mill, it was decided to try the experiment of eliminating agitation altogether. This worked out very well, and the mill is now running without agitators. These agitators probably would be entirely successful on a true sliming ore.

The main part of the mill consists of the two floors mentioned, one containing the grinding machinery and the other the cyanide tanks and filter. However, there is a small third floor running along the front of the mill, which forms a concrete tank of 10,000 cu.ft. capacity. The mill has concrete floors which drain into this tank, and any leakage or breakage throughout the plant is caught here. This tank has performed good service and has paid for itself several times over. If necessary, we can empty any tank in the mill and flush the contents with fire hose into this sump, whence it can be pumped back to the classifier.

The mill has not operated long enough to obtain an accurate account of costs, but they are approximately as follows per ton on an 80-ton basis. The consumption of cyanide is 0.5 lb. per ton; zinc dust, 0.5 lb.; lime, 2 lb.; power at 2c. per kw.-hr., $0.44; labor and superintendence, $0.41; chemicals, etc., $0.27; repairs and miscellaneous, $0.25; making a total cost per ton of $1.37.

The Mining Debris Problem

A notable contribution to geological literature in its broadest relations has been completed for publication by the United States Geological Survey. The report, which will be issued during the coming year, is entitled "Hydraulic Mining Débris in the Sierra Nevada" and represents an extremely thorough investigation by Grove Karl Gilbert. In a memorial presented to the President of the United States in 1905, the California Miners' Association, after emphasizing the contribution of placer and hydraulic mining to California and to the nation, expressed the conviction that a rational application of the natural laws governing the deposition of sediment from torrential streams would permit both hydraulic mining and agriculture to be carried on in this region, not only without hinderance to each other, but to their mutual advantage. In the belief that the question was primarily geological, as it involves the study of erosion and of sedimentation in the mining districts as well as in the lower valley regions, the association requested that the Director of the United States Geological Survey should be instructed "to undertake a particular study of those portions of the Sacramento and San Joaquin valleys affected by the detritus from torrential streams."

The investigation then begun by Mr. Gilbert was planned to include a field study of the natural phenomena connected with the problem and a laboratory study of the laws of transportation of detritus by running water. The results of this laboratory study have already been published in Professional Paper 86 of the United States Geological Survey, entitled, "The Transportation of Débris by Running Water," and the report just prepared, which deals with the geologic and physiographic phases of the problem, presents the results of the completed investigation and contains conclusions much broader than the answers to the specific questions raised by the California Miners' Association.

This report, which will be published as Professional Paper 105, will also assist materially in solving the problem, which involves mining, agriculture and navigation. The studies cover every phase of the subject, from the original source of the detritus in the Sierra Nevada to the possibility of its transportation through the Golden Gate to the Golden Gate Bar, and in his broad treatment Mr. Gilbert has not only estimated the waste due to agriculture, grazing, roads and trails, and mining and studied its movement seaward, but he has supplemented his observations and estimates with instrumental surveys of impounded detritus as well as with measurements of tidal currents in the Golden Gate.

The investigator appreciated the fact that the problem was complex, involving many factors other than those directly connected with mining, and recognized that the beneficial use of these rivers, now overburdened with débris, must be effected by coöperative endeavor on the part of several interests. The public interests in agricultural reclamation, as well as in placer mining, must now be harmonized with the public interest in navigation. In its conclusions, therefore, this scientific study, which had its origin in the antagonism of mining and agriculture, is found to involve a question of relative values between commerce and agriculture, as well as between mining and irrigation and power development.

Diagrams from Air Compressor

The accompanying indicator diagrams, by R. S. Hawley in *Power*, Dec. 12, were taken from the air cylinders of a two-stage tandem compressor. Figs.

FIG. 1. VERY POOR DIAGRAM FROM HIGH-PRESSURE CYLINDER

1, 3 and 5 show the high-pressure diagrams, and Figs. 2, 4 and 6, the low-pressure diagrams. A 40-lb. spring was used for the high pressure and a 60-lb. spring for the low pressure. The valves of the compressor are of the

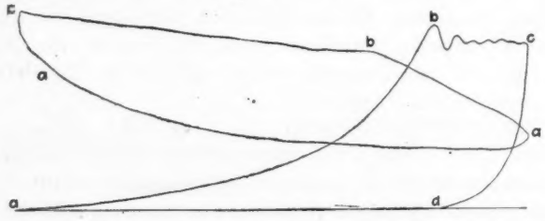

FIG. 2. LOW-PRESSURE DIAGRAM WITH LEAK IN INTERCOOLER INDICATED

spring-poppet type inserted in cages and the cages screwed into the cylinder head. The lower end of each cage presses against a copper gasket, which prevents leakage at that point.

Before the diagrams were taken the compressor was pounding badly, its strokes were not uniform and the

FIG. 3. HIGH-PRESSURE CYLINDER DOING LITTLE WORK

low-pressure cylinder was excessively hot. Pressure in the receiver could not be maintained as usual, and the consequent decrease in the air supply was noticeable.

Diagrams 1 and 2 were then taken. Fig. 1 shows that the high-pressure cylinder is doing little work. The diagram is so irregular that it is impossible to follow the events of the stroke. The head end of Fig. 2 is nearly perfect in form, but the compression is too high. Air

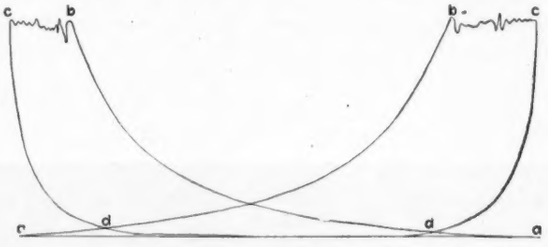

FIG. 4. TOO HIGH DISCHARGE PRESSURE FOR LOW-PRESSURE CYLINDER

enters along line *da* at atmospheric pressure, is compressed along *ab* to about 60 lb. pressure and is delivered along *bc*. Reëxpansion of air in the clearance space then occurs along *cd*. The crank-end diagram shows that air enters this end of the cylinder at an average pressure of

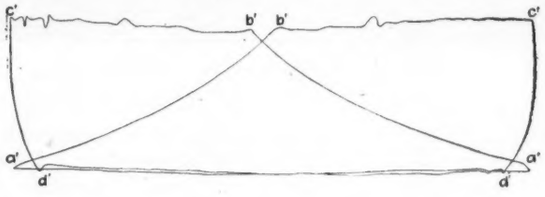

FIG. 5. HIGH-PRESSURE DIAGRAMS—REPAIRS COMPLETED

about 30 lb. This indicates a leakage from the intercooler back through the discharge valves into the cylinder.

Examination of the valves on the low-pressure showed that the gaskets under the cages were all defective or broken out, allowing air to pass back into the cylinder from the intercooler. After these gaskets were renewed, diagrams 3 and 4 were taken. Fig. 4 is of good form,

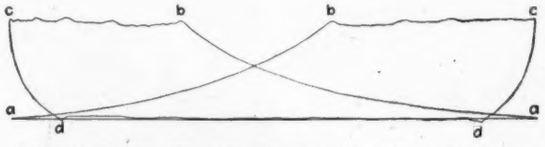

FIG. 6. LOW-PRESSURE DIAGRAMS—REPAIRS COMPLETED

but the extremely high pressure of discharge indicates that the valves are operating against practically receiver pressure. Fig. 3 shows that little work is being done by the high-pressure cylinder, and since all the air must pass through this cylinder, considerable leakage through its valves is indicated. Examination of the valves of this cylinder showed that the gaskets were all so badly worn as to be useless, so the piston was simply churning air back and forth while the low-presure was doing all the work of compression. After repairs were made, Figs. 5 and 6 were taken. The compressor is working against too high a pressure for best results.

Packing Between a Cylinder Head and the cylinder should be thin, the thinner the better. Thick packing is more likely to blow out, and the additional thickness unnecessarily increases the clearance in the cylinder.

Efficiency of Compressed-Air Installations--I

By Theodore Simons*

SYNOPSIS—One pound of air is followed through the various stages of compression, transmission and use, and the final efficiency is calculated. Its lowness (10-25%) calls attention to the need of care in compressed-air operation. Suggestions and examples show how efficiencies in compression can be increased by proper design of equipment.

The engineer who has occasion to study mining operations in various camps cannot fail to be struck by the surprisingly low mechanical efficiency of many of the compressed-air installations. Upon investigation he will find that unsatisfactory conditions are usually due to lack of a rational conception on the part of the operator regarding the occurrence of avoidable and unavoidable losses in such installations and to failure to realize the magnitude of these losses.

Air is such an unstable substance that an installation doing satisfactory work in one locality, if exactly duplicated in another, may prove a complete failure. In designing and operating the plant, all local conditions, particularly those referring to altitude, must be given due consideration in order to accomplish results that are satisfactory both from a technical and economic point of view. In this connection it must be borne in mind that the plant showing the highest mechanical efficiency is not necessarily the most economical one.

The Question of Mechanical Efficiency

The mechanical efficiency of a compressed-air installation, consisting essentially of compressor plant, pipe line and air engines, is evidently the ratio of the useful work performed by the air engines and the actual work required to produce and transmit the compressed air operating the engines.

Perhaps the most lucid way of realizing all possible losses that may occur in the production, transmission and use of compressed air is to follow a definite quantity of air—one pound, for instance—from the moment it enters the air cylinder of a compressor until it is exhausted from the cylinder of the air engine. To do this we must imagine that the pound of air, upon being discharged from the compressor, is left entirely to itself while traveling to and through the air engine and is not assisted in any way by new compressed air coming in behind it, as it is in actual practice at the expense of extra energy for which there is no useful return.

The theoretical net work required to compress adiabatically in one stage V_a cu.ft. of air from an initial absolute pressure P_a to an absolute pressure P_2 in pounds per sq.in. and to deliver the compressed air at that pressure into the receiver is

$$W_n = \frac{144 n P_a V_a}{n-1}\left[\left(\frac{P_2}{P_a}\right)^{\frac{n-1}{n}} - 1\right] ft.\text{-}lb. \qquad (1)$$

in which $n = 1.406$.

First Loss[1]—Assume the outside temperature to be 62° F. Upon entering the air cylinder of the compressor, the temperature of the pound of air, as it passes over the heated inlet valves and cylinder walls of the compressor, is increased. How much we have no direct means of measuring. For our problem we will assume that it is raised to 80° F. The direct effect of this is an increase in the volume of the pound of intake air and, as a consequence, an increase in the power required to compress it. This loss is unavoidable, but can be minimized by properly dimensioning the compressor and providing it with ample cooling devices.

One pound of 62° air at sea level (atm. pres. = 14.7 lb.) occupies a volume of 13.141 cu.ft. Heated to 80° F., it occupies a volume of $V_a = 13.593$ cu.ft. To compress this volume adiabatically in one stage to 80 lb. gage and deliver it into the receiver requires theoretical work (from equation 1),

$$W_n = 71{,}400\ ft.\text{-}lb. \qquad (2)$$

The volume V_2 which the pound of air occupies after compression, we find from equation

$$V_2 = V_a\left(\frac{P_a}{P_2}\right)^{\frac{1}{n}}$$

or

$$V_2 = 13.593\left(\frac{14.7}{94.7}\right)^{0.71} = 3.6\ cu.ft. \qquad (3)$$

Second Loss—This is due to clearance and volumetric efficiency of the compressor. Clearance is necessary for well-known mechanical reasons. Its effect is the cutting down of volumetric efficiency. The clearance air, upon expanding on the return stroke of the piston, takes up part of the cylinder contents, leaving only a portion of it for incoming free air. As a result, at each stroke not a cylinderful of new free air is taken in, but a volume diminished by the volume of the expanded clearance air. This means that, in order not only to compress but to deliver a definite quantity of air per stroke, the volume of the intake cylinder must be made larger by the volume of the expanded clearance air.

The latter, in expanding, helps compressing an equal amount of air on the other side of the piston. Theoretically, therefore, clearance affects volumetric efficiency only and not the power required for compression. In practice, however, the fact that the compressor must be larger in order to take care of clearance losses entails more friction and therefore an increased consumption of power.

Third Loss—In addition to compressing air, the energy supplied to a compressor must also overcome friction and inertia of the moving parts of the engine. The energy consumed is a loss that is unavoidable, but can be minimized by intelligent design of the compressor and by proper care on the part of the operator.

Losses 1, 2 and 3, being due to variable conditions, are not susceptible of precise computation. It is custom-

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[1]In this paper all losses are based on a comparison with operations carried on at sea level.

ary to make allowance for these three losses by adding 15% to the theoretical power required for compression and delivery, as found by equation 1.

Referring to equation 2 and adding 15%, we get actual work:

$$W_n' = 82{,}200\ ft.\text{-}lb. \qquad (4)$$

Fourth Loss—The theoretical absolute temperature of the pound of compressed air when leaving the compressor is

$$T_2 = T_a \left(\frac{P_2}{P_a}\right)^{\frac{n}{n-1}} = 0.29$$

in which $T_a = 80 + 461 = 541°$; $P_2 = 94.7$ lb., and $P_a = 14.7$ lb.
whence

$$T_2 = 930°\ absolute. \qquad (5)$$

Under favorable conditions the actual temperature of the compressed air should be less, owing to radiation and water cooling. In many installations it is found to be more, because of imperfections of the compressor, such as leaks around piston and sticky discharge valves.

The volume of the pound of compressed air from equation 3 is $V_2 = 3.6$ cu.ft. In actual practice the air cools to outside temperature (62° F.) before reaching the air engines. If left alone its pressure would decrease to

$$P'_2 = P_2 \left(\frac{T_a}{T_2}\right)$$

in which $T_a = 62 + 461 = 523°$ and $T_2 = 930°$
whence

$$P'_2 = 53\ lb.\ absolute. \qquad (6)$$

This represents a pressure loss of 42 lb. due to dissipation of compression heat. It is by far the greatest loss occurring in compressed-air installations and, in general, it is unavoidable.

Unavoidable Losses in the Transmission of Compressed Air

The pound of air on entering the pipe line may be considered as occupying a volume $V_2 = 3.60$ cu.ft. (from 3) and to have a pressure $P'_2 = 53$ lb. abs. (from 6).

Fifth Loss—In passing through the pipe line, the air undergoes a further loss of pressure due to friction. The smaller the pipe the greater the friction and the greater the pressure loss. This loss is unavoidable, but can be minimized by ample dimensions of pipe. For our problem we will assume that the loss amounts to 5 lb. The pressure of the pound of air at the discharge end of the pipe line is, therefore,

$$P_3 = 48\ lb.\ abs. \qquad (7)$$

This decrease in pressure is accompanied by an increase in volume, hence loss of potential energy due to loss of pressure is partly compensated by increase of volume.

The new volume will be

$$V_3 = V_2 \left(\frac{P'_2}{P_3}\right) = 3.60 \left(\frac{53}{48}\right) = 4\ cu.ft. \qquad (8)$$

Sixth Loss—In compressed-air installations it often happens that the engines using the air are situated at a considerable elevation above the compressor plant. Failure to take that fact into account leads to unsatisfactory results such as may be observed in many existing installations.

If air at a given pressure is to be delivered through a pipe at a point above the compressor plant, it stands to reason that in addition to the energy required for merely making the air flow, as in a horizontal pipe, energy is required to lift the air from the compressor up to the point of use.

The problem usually appears in the form of an example such as: A set of mine pumps, situated 1,500 ft. vertically above the compressor plant require air at 80-lb. gage. The compressor is at an elevation of 5,000 ft. above sea level and is capable of compressing air to 90 lb. gage. How much pressure can we afford to lose in the pipe line?

Air pressures at different elevations may be ascertained very closely from the following equation:

$$log\ P_2 = log\ P_1 - 0.0000157\ h \qquad (9)$$

in which P_2 = absolute pressure of air in lb. per sq.in. at top, P_1 = absolute pressure at bottom, and h = vertical distance in feet between top and bottom.

Atmospheric pressure at pumps (from equation 9), $\log P'_2 = \log 14.7 - 0.0000157 \times 6{,}500$; whence $P'_2 = 11.6$ lb. per sq.in.

Atmospheric pressure at compressor, $\log P'_1 = \log 14.7 - 0.0000157 \times 5{,}000$; whence $P'_1 = 12.3$ lb.

Absolute pressure required in air cylinders of pumps, $P_2 = 80 + 11.6 = 91.6$ lb. absolute.

Absolute air pressure required at bottom of pipe, neglecting friction, $\log 91.6 = \log P_1 - 0.0000157 \times 1{,}500$; whence $P_1 = 96.7$ lb. abs.

Since the selected machine compresses to $90 + 12.3 = 102.3$ lb. abs., we can afford a pressure loss, due to friction in pipe line of $102.3 - 96.7 = 5.6$ lb., and the dimensions of the pipe must be computed accordingly.

Had the machine in the instance stated been able to compress air only to 84 lb. gage, the air at the pumps would never have reached a pressure of 80 lb. gage, no matter how large the pipe had been made.

Loss 6 is unavoidable and cannot be minimized by any known means. To bring the compressor up to the same level with the pumps would entail an equivalent loss as explained under loss 10.

Seventh Loss—We have in the end a pound of air occupying a volume of 4 cu.ft. at a pressure of 48 lb. absolute to operate the air engine (equations 8 and 7). In order to overcome the friction of the engine near the end of the stroke and to cause the air to properly exhaust against the back pressure, the exhaust pressure P_1 must be somewhat above atmospheric pressure P_a at the particular locality; hence all the energy residing in the pound of compressed air is not available for doing useful work. This is an unavoidable loss.

The theoretical work W_n which a volume V_3 cu.ft. of air at an absolute pressure P_3 lb. can develop during admission and partial adiabatic expansion is

$$W_n = 144\left(P_3 V_3 + \frac{P_3 V_3 - P_1 V_1}{n-1} - P_a V_1\right) ft.\text{-}lb. \qquad (10)$$

in which V_1 = volume of exhaust air.

If the engine is adjusted to exhaust at 16.5 lb. absolute pressure (atm. pres. being 14.7 lb.), then

$$V_1 = V_3 \left(\frac{P_3}{P_1}\right)^{\frac{1}{n}} = 4 \left(\frac{48}{16.5}\right)^{0.71} = 8.5\ cu.ft. \qquad (11)$$

$$W_n = 144\left(48 \times 4 + \frac{48 \times 4 - 16.5 \times 8.5}{0.406} - 14.7 \times 8.5\right) = 28{,}000\ ft.\text{-}lb. \qquad (12)$$

Eight Loss—Part of the energy is consumed in overcoming friction, inertia, etc., of the air engine. To obtain the actual useful work performed, it is customary to subtract 15% from the theoretical work; thus,

$$Actual\ work\ W'_a = 23{,}800\ ft.\text{-}lb. \qquad (13)$$

Mechanical Efficiency of System at Sea-Level

$$E = \frac{actual\ work\ performed\ by\ air\ engine}{actual\ energy\ consumed\ by\ compressor} = \frac{23{,}800}{82{,}200} = 29\%$$

In the preceding calculations rather perfect conditions were assumed and unavoidable losses only were considered in the computation of efficiency.

Ninth Loss—In rock drills and underground mine pumps, compressed air is generally used nonexpansively, for the principal reason that such machines are simpler in construction, smaller in bulk, lighter in weight and therefore easier to handle and to manipulate. These advantages alone compensate to a large extent for the losses due to the air being exhausted practically at full pressure. In underground operations the loss is further compensated by the fact that the exhaust air furnishes ventilation that would have to be provided by other artificial means.

Using compressed air nonexpansively nevertheless entails an actual loss which it is well to recognize when planning an installation. Air drills of the reciprocating type, inasmuch as they perform useful work only on the forward stroke, are (theoretically) the least efficient machines as regards consumption of energy.

The theoretical net work in foot-pounds that a volume V_1 cu.ft. of compressed air is capable of performing, when used nonexpansively is

$$W_n = 144(P_1 - P_a)V_1\ ft.\text{-}lb. \qquad (14)$$

in which P_1 and P_a = absolute pressure in pounds per square inch of initial and of back pressure respectively.

According to equations 7 and 8 the pound of air as it leaves the pipe line has a volume of 4 cu.ft. and a pressure of 48 lb. abs. If employed nonexpansively to operate an air drill, we can perform work (from equation 14) to the amount of:

$$W_n = 144(48 - 14.7)4 = 19{,}200\ ft.\text{-}lb.\ (theoretical) \qquad (15)$$

Subtracting 15% for unavoidable mechanical defects, we get actual W_n = 16,300 ft.-lb. Since only half of the work is useful work, we have

$$Useful\ work\ of\ drill = 8{,}150\ ft.\text{-}lb. \qquad (16)$$

From equation 4, the actual work required to produce the 4 cu.ft. of compressed air is W'_n = 82,200 ft.lb.; hence the efficiency of the system, using air nonexpansively to run rock drills, is

$$E = \frac{8{,}150}{82{,}200} = 10\%\ (approx.) \qquad (17)$$

Such low efficiency, in spite of the assumption of rather perfect conditions, evidently points to the necessity of guarding assiduously against all losses that are avoidable.

The Effect of Altitude on Efficiency

Tenth Loss—At high altitudes we shall find efficiencies to be still lower, though the conditions may be as perfect as at sea level. This is due to the fact that in order to produce at an altitude a certain volume of compressed air having a pressure of, say, 80-lb. gage, which is equal to a volume of 80-lb. air produced at sea level and can therefore do the same amount of work, we must start with a larger volume of free air at the altitude compressor and must therefore spend more power in compressing it. The required volume may be ascertained either from tables or from the following equation:

$$V_1 = V_a \frac{P_a(p + P_1)}{P_1(p + P_a)} \qquad (18)$$

in which V_1 = volume of free air at altitude (atmospheric pressure P_1) which, after being compressed to a gage pressure p, is equal to a volume of 80-lb. air produced at sea level from a volume V_a of free air (atmospheric pressure P_a).

Solved for an altitude of 8,000 ft. above sea level (atmospheric pressure = 10.87 lb.), the pound of 80° free air would occupy a volume of

$$V_1 = 13.593 \frac{14.7(80 + 10.87)}{10.87(80 + 14.7)} = 17.6\ cu.ft. \qquad (19)$$

To compress this volume adiabatically in one stage to 80 lb. gage and deliver it into the receiver at that altitude requires (from equation 1)

$$W_n = 81{,}200\ ft.\text{-}lb.\ (theoretical) \qquad (20)$$

and

$$W'_n = 93{,}400\ ft.\text{-}lb.\ (actual) \qquad (21)$$

which is 14% more than at sea level (see equation 4).

The amount of work we can perform with this pound of compressed air is practically the same at the altitude as at sea level; that is, 23,800 ft.-lb. (from equation 13). This gives the mechanical efficiency at 8,000 ft. altitude as

$$E = \frac{23{,}800}{93{,}400} = 25\% \qquad (22)$$

The Avoidable Losses in the Production of Compressed Air

Eleventh Loss—Assuming that a compressor has been installed of proper design and capacity to supply the normal demands of a plant, it will nevertheless fail to do the desired work if not properly treated. The best compressor will fall short of the performance claimed by the builder, if, for instance, the intake air is not as cool as might be; that is, if it is taken from the sunny side of the compressor building or from near a boiler plant, etc.

Had the temperature of the pound of intake air been 90° F. instead of 62° F., it would have occupied a volume of 13.845 cu.ft. Upon being heated to, say, 100° F. by passing over the heated inlet valves of the compressor, its volume would have been 14.096 cu.ft. To compress to 80 lb. gage and deliver this pound of air at sea level, as before, would take (from equation 1)

$$W_n = 74{,}000\ ft.\text{-}lb.\ (theoretical) \qquad (23)$$

Compared with equation 2, this shows an increase of 4% in the required power due to an increase of 28° F. in the temperature of the intake air, or 1% for every 7°.

The volume of the compressed air in the first case was V_2 = 3.60 cu.ft. (from equation 3); in the second case it would be

$$V_2 = 3.74\ cu.ft. \qquad (24)$$

either volume weighing one pound. Since the energy residing in the pound of air for doing work depends on volume as well as on pressure, it would seem that though we spent more work in producing this increased volume,

we could also perform more work with it. This would be true if the compressed air could be employed as soon as it leaves the compressor. But during transmission to the points of use all of the compression heat is dissipated.

The increase in volume due to an increase in the temperature of the intake air is therefore only temporary and not available for doing useful work. Hence the extra energy expended in producing it is sheer waste. This points to the advantage of bringing air to the compressor as cool as possible.

Twelfth Loss—Frequently compressors are installed that are not suited for the required work and are therefore inefficient. At camps situated far above sea level, I have often seen in operation small and large compressors designed for sea-level performance and therefore unsuited for the work. The effect of altitude has been pointed out under loss No. 10. Assuming that a compressor has been selected of a capacity corresponding to equation 13, the energy required to compress in one stage, say, 1,000 cu.ft. of free air per min. to 80 lb. gage at an elevation of 8,000 ft. above sea level (atmospheric pressure = 10.87 lb.) is 140 hp. (theoretical). (25)

A compressor designed to compress 1,000 cu.ft. of free air per min. at sea level consumes 160 hp. (26)

Using such a compressor at a higher elevation entails, a waste of energy for which there is no useful return.

For temporary work it may be quite legitimate to employ a compressor that can be bought cheaply, though not especially adapted to the work; but for continuous performance the compressor should be designed for the altitude at which it is to be installed.

Thirteenth Loss—Neglect of frequently removing the accumulated carbonaceous matter of the lubricating oil from the valves in the air cylinder leads to a contraction of the air passages, to an increase in pressure and temperature of intake and discharge air, and as a consequence, to a loss of energy. The wasteful effect of high temperatures has already been pointed out. Improper lubrication causes pistons to wear loose, permitting leakage of the compressed air into the intake side of the air cylinder. This, in its turn, results in a cumulative increase in the temperature of the intake air with the consequent losses referred to and with the danger of an explosion and all the expense and annoyance due to an interruption in operation.

Fourteenth Loss—A compressor not provided with an automatic regulator, when used to supply an intermittent demand, as happens so often in mining operations, is very wasteful of energy in that any surplus air is simply blown off through the safety valve of the receiver without doing useful work. This is another loss that is excusable only in temporary work when the extra cost of regulating devices is not warranted.

(*To be concluded*)

Chilean Nitrate Production

September was notable for the large exportation of sodium nitrate from Chilean ports, the 7,697,000 quintals (390,268 tons) shipped being the record for any month and an increase of 3,359,000 quintals over August, according to a recent communication in *Commerce Reports* of the Department of Commerce. This increase in exports was due to the unusual amount of tonnage available in the nitrate ports. The large shipments have served to reduce the stock of nitrate at coast ports, and recently some of the railroads have been taxed to their capacity to bring sufficient nitrate from the *oficinas* in the interior to supply ships waiting for cargo.

Production during September was about 669,000 quintals less than in the previous month, being 4,724,400 quintals, against 5,393,391 for August. Compared with September in the three preceding years, the production and exportation of Chilean nitrate were:

SEPTEMBER PRODUCTION OF NITRATE IN CHILE

	Production Quintals	Exportation Quintals
1916	4,724,400	7,697,000
1915	3,492,260	3,970,004
1914	2,855,330	2,119,891
1913	4,516,288	4,118,906

Prices of nitrate advanced during the month, but there were greater advances for early deliveries than for deliveries during 1917, and the market was much firmer for prompt supplies. Ordinary nitrate was quoted at $1.95 to $2.07 per quintal, depending on delivery offered. For refined, 96% less 1%, prices were $2.11 for early delivery and $2.03 for 1917 delivery.

Tunnel Survey Methods Used Driving Strawberry Tunnel

The Strawberry tunnel, constructed by the United States Reclamation Service in connection with the storage works of the Strawberry Valley Irrigation Project, is located under the rim of the Great Basin, in Utah and Wasatch Counties, near Provo, Utah. The tunnel is about 3½ mi. long and is straight for its entire length. The finished section is 7 ft. wide by 8 ft. 6 in. high, with an arched top. About 3 mi. of the tunnel was driven from the lower or west portal, and ½ mi. from the upper or east portal. As Project Engineer, J. L. Lytel was in charge of the construction of the tunnel, while the engineering work was in direct charge of F. W. Cater, Assistant Engineer. Several other engineers, of whom the writer was one, were employed from time to time on the routine engineering work.

The profile of the ground surface along the tunnel line was such that only two intermediate set-ups were necessary between the two portals. Four large concrete monuments were therefore placed along the tunnel line, one just beyond each portal and one at each of the two intermediate points. The exact location of the line on these monuments was checked from time to time and was finally decided upon some time before the work was started at the east portal. Two independent "double rodded" level lines were run along the wagon road between the two portals, a distance of about 7 mi.; and as these checked by less than 0.10 ft., which was close enough for construction purposes, no further work was deemed necessary. The distance along the line (about 3½ mi.) was determined with a slope board. Two independent measurements gave results differing by less than a foot, and so it was not thought necessary to determine the length by triangulation. This work was done by the resident or assistant engineer in charge and one or two rodmen, as necessary.

The construction line in the tunnel was carried on screw hooks placed on the center line of the tunnel, either on wooden plugs driven into holes drilled in the roof, or on timber sets where convenient. These screw hooks were placed 50 ft. apart throughout the tunnel, and a new one

*By L. M. Hammond, Assistant Engineer, United States Reclamation Service, Provo, Utah, in Engineering News, Dec. 7, 1916.

was placed whenever the last one became 125 ft. from the heading. In order to facilitate the handling of muck-cars in the heading a section of double track, about 200 ft. long and with a switch at either end, was kept as close to the heading as possible. Hooks to be used as set-up points were set with special care at a point approximately in the center of this section. By setting the transit up in this particular spot it was possible to move empty muck-cars from a point ahead of the transit to the heading and back, leaving them (when loaded) on the other track, but still ahead of the transit. In this manner, construction work was not in any way interfered with, which is perhaps the most important feature of tunnel surveying.

A plumb-bob suspended from the previous set-up point and illuminated by electric lights if convenient, and by candles if not, served as a backsight, so that only two men were required for this work, one at the instrument and the other at the foresight. When the screw hooks were placed in plugs in the roof, there was practically no danger of their shifting; but when placed on timber sets, they had to be checked constantly, and it was customary after taking a backsight to check on one or two intermediate hooks before setting the new point ahead.

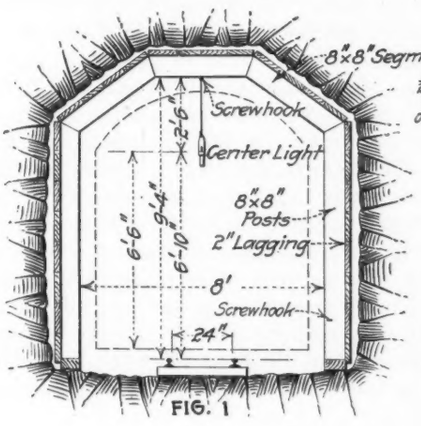
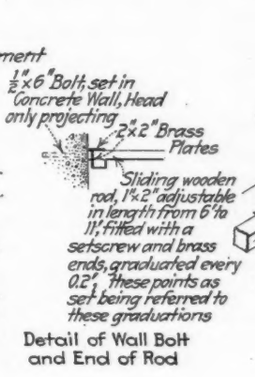


FIG. 1


1"x6" Bolt, set in Concrete Wall, Head only projecting
2"x2" Brass Plates
Sliding wooden rod, 1"x2" adjustable in length from 6" to 11", fitted with a setscrew and brass ends, graduated every 0.2", these points as set being referred to these graduations
Detail of Wall Bolt and End of Rod

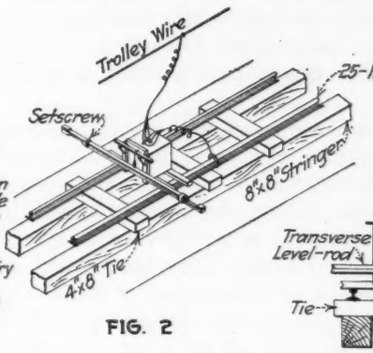
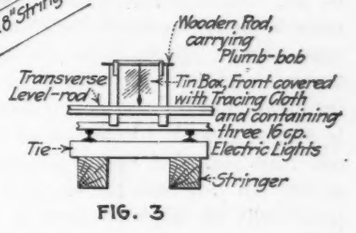


FIG. 2


Wooden Rod, carrying Plumb-bob
Transverse Level-rod
Tin Box, Front covered with Tracing Cloth and containing three 16 cp. Electric Lights
Tie
Stringer
FIG. 3

FIGS. 1 TO 3. SPECIAL SCHEMES IN STRAWBERRY TUNNEL SURVEY
Fig. 1—Sketch of location of construction-line points. Fig. 2—Arrangement for reading exact alignment on transverse level-rod. Fig. 3—Light-box

The location of the center lights and their relation to the screw hooks and the neat lines of the tunnel, are shown in Fig. 1. The elevation of the screw hook once determined, it was an easy matter to adjust the length of the wire holding the center light (a candle stuck in a bushing) so as to bring the flame of the candle to the springing line of the arch. There were two of these center lights, one for each of the last two center hooks set. To avoid confusion a metal tag was kept fastened to the head light. This system of center lights was devised to give the shift boss or superintendent line and grade without the necessity of calling on the engineer at any time of day or night that he saw fit; and it made it necessary for the engineers to go into the tunnel only whenever a new center hook was necessary—at every 50-ft. progress of the tunnel, or approximately every third day. By hanging the two lights on their respective hooks the shift boss had a "line of sight" that would give both line and grade, sufficiently accurate for his purposes, at the face of the tunnel (or any other point) at any time. Having one fixed point, it was easy for him to "spot" the locations of the various holes to be drilled.

Control Line and Grade in Tunnel

Permanent benchmarks (for levels) were placed at various points in the tunnel, and the elevations of the construction points in the heading were checked up from one of these benchmarks at least once a month (from 300 to 500 lin.ft.). The elevations of the benchmarks were checked up occasionally from the portal benchmark. A 22-in. Gurley Y-level was used for all work, and sights were limited to 200 ft. and kept equal. While this instrument was somewhat heavy and cumbersome for tunnel work, the increased accuracy and its ability to hold its adjustments under somewhat trying conditions compensated for the inconveniences.

The apparatus used in checking the line is shown in detail in Fig. 2. For the first 2 mi. of tunnel, concrete monuments were placed at 1,000 ft. intervals along the floor of the tunnel and the line carried on them. At that point, however, a 7-sec.-ft. flow of water was encountered in the heading, which covered the floor of the tunnel with a foot or more of water and rendered useless all the carefully determined and preserved monuments up to that point. An entirely new system of marks was then determined upon and the line rerun several times.

Bolts were set in the concrete wall of the tunnel (or in the rock wall, if the tunnel had not yet been lined) about 1 ft. above the level of the water, with only their heads projecting. Three adjustable wooden rods were then made. The ends were capped with brass and had a small projecting brass lip (as shown), so that the ends of the rods could be made to rest upon and butt against the bolts on either side of the tunnel. The point was then determined on the rod. The rods were graduated to the nearest 0.2 ft., and the points as set were recorded as being so far to the north or south of any one graduation. It was thus an easy matter to take a numerical average of the

location of the various shots. The rods were numbered, and the same rod was always used at any particular station. The point as finally determined was marked on the rod, and its location was carefully noted, so that it could be restored if obliterated. As temperature and humidity were practically constant, expansion and contraction were negligible; and it was possible for a point, once determined, to be relocated in practically exactly the same place at any future time.

These "benchmarks" were located at 1,000-ft. intervals (there were 16 between the west portal and the point where the headings met). The foresight was always kept at 1,000 ft., and the backsight was varied between 1,000 ft. and 5,000 ft. according to conditions.

The greatest difficulty, of course, was in getting the line started into the tunnel. In order to avoid heat waves and condensation of moisture, it was necessary to select a time when the temperature inside and outside the tunnel was about the same, but even with the best of conditions it was necessary to take more than 100 shots on each of the first two points in the tunnel before results satisfactory to the observers were obtained. Once inside the tunnel the work was much easier, and from 8 to 24 shots were usually sufficient to determine a point with a fair degree of accuracy.

One of the hardest tasks connected with the engineering on any construction feature, and particularly on tunnel construction, where all the work is being carried on in a very narrow space, is to do the engineering in such a manner and at such times as to cause the least delay and inconvenience to the construction. The superintendent is almost always intolerant of delays, and it is hard to convince him that the engineers have difficulties as well as he. In this case the engineering work was done with practically no delay whatever to the construction work.

Inasmuch as the driving of the tunnel was carried on with three shifts, a great deal of time was lost in disturbing and readjusting the instrument and sights to allow the muck trains to pass. The concreting gang worked only in the daytime; and so this engineering work was done at night, as it would have been absolutely impossible to dodge both muck and concrete trains and still do any work.

Light-Box and Instrument

The method of supporting and illuminating the plumb-bob is shown in Fig. 3. It will be noticed that the plumb-bob, its support and light are entirely independent of the rod on which is the "monument," being supported on the tramway tracks.

Six men were always used on this work, two each at backsight, instrument and foresight. The men at the instrument and foresight took turns with their work, while the extra man at the backsight acted as messenger whenever necessary. Owing to the fact that the work was done at night, in long shifts, in a very wet and comparatively cold place and in a tedious and painstaking manner, it was exceedingly fatiguing to all the party.

The instrument used was a large Berger transit-theodolite. It gave excellent results and held its adjustments well. The instrument used in the construction work at the heading was a small Buff & Berger transit, which did very satisfactory work.

When the two headings met, it was found that there was an error in alignment of 0.18 ft., in grade of 0.13 ft., and in chaining of 2.5 ft. Considering the difficulties encountered and the fact that at no time was construction work interfered with, these results were considered satisfactory.

The methods and apparatus described are not exactly original with this tunnel, they being in some respects patterned after the methods used in the Gunnison tunnel, Colorado; neither can the changes and improvements be ascribed to any one man. They are an evolution rather than an invention.

Corrosion of Cast Iron

According to B. Bauer and E. Wetzel, in *Mitt. K. Materialprüf,* 1916, XXXIV, 11-40, through *Journ. Soc. Chem. Ind.,* cast iron embedded in moist soil is subject to a peculiar form of corrosion, known as "graphitization," "iron cancer," etc., in which it is converted locally into a soft, friable, gray mass. The authors have investigated a number of cases of corrosion of this type and also made experiments with the object of producing similar effects in laboratory tests. Their results indicate that the fundamental condition for the production of corrosion of this kind is the presence of water in the liquid state. The phenomenon is usually associated with gray cast iron, but white cast iron may be corroded in a similar manner. The corrosion is accelerated by the application of an electric current—for example, by stray currents in the soil—but also takes place, though much more slowly, in the absence of external electric currents. The oxidation products of the iron, in a spongy condition at first, are retained in place by the network of graphite in the case of gray cast iron, or of cementite in the case of white iron, and are gradually agglomerated to a more or less firm mass. In gray cast iron the corrosion appears always to proceed from the laminæ of graphite and gradually to spread outward.

Taxation of Mine Proceeds

By A. L. H. Street*

The provisions of the Idaho statutes for taxation of mining property by assessing the net proceeds of operations for the preceding year, instead of basing the tax on the value of orebodies in place, were recently attacked before the United States District Court for the District of Idaho as being violative of the state constitution, which requires all taxes to be levied in proportion to value and to be uniform upon the same class of subjects. The court, however, upheld the validity of the statutes. (Hanley vs. Federal Mining and Smelting Co., 235 Federal Reporter, 769.)

Vanadium in Peru is found as the chief element of a mineral deposit, according to a recent consular report. The mines at Minasragra, the largest in the country, are the property of the American Vanadium Co. The exports of this mineral for the last five years were as follows: 1911, 2,251 tons; 1912, 3,048 tons; 1913 and 1914, exports suspended; 1915, 2,526 tons to the United States. The production is, of course, controlled by the vanadium company, which regulates its output according to its demands. Larger quantities, it is stated, could easily be produced. There exists a zone in the Department of Junin where numerous veins of asphaltite are to be found, which are analogous to the grahamite, gilsonite, and albertite found in the United States, with the peculiarity that nearly all contain vanadium, some having as much as 30% of vanadic acid in the ash.

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Reduction of Stope Contours

By J. J. Bristol*

SYNOPSIS—The ordinary reduction of stope contours is accomplished by means of pantographs, successive steps being required to accomplish the necessary scale reduction and also the reduction of inclined stoping values to horizontal components. A compact, rigid appliance to accomplish this result in one operation is described. This consists of a reduction pantograph to which is attached a cosine pantograph, the entire apparatus operating in a horizontal plane.

This article considers mainly the mechanical reduction of stope contours from the plane of the vein or slope plane to the horizontal plane by means of modified pantographs. These, while adaptable to various reductions or projections, have been evolved primarily in connection with the methods of stope measurement used on the Witwatersrand

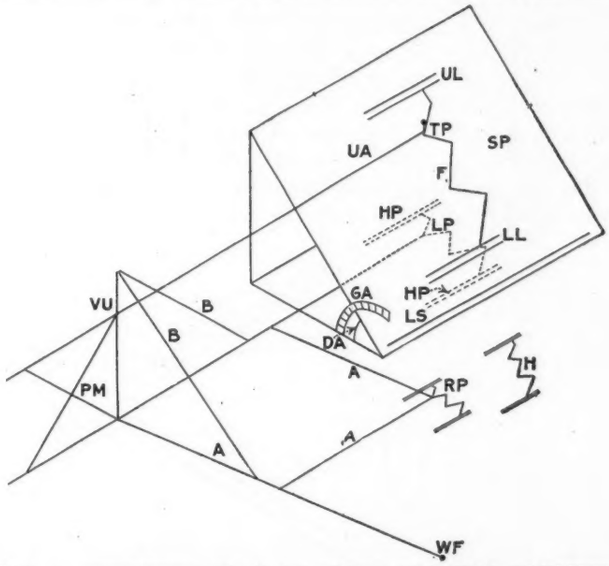

FIG. 1. ISOMETRIC PLAN OF STOPE SHOWING PRESENT PANTOGRAPH REDUCTION PRACTICE

of South Africa and minor African localities as a means of quickly and accurately reducing the contours of stopes as plotted on the slope plane to the horizontal plane of the working plan.

Since the points used to determine the face contours are on the hanging wall, it is taken as the stope plane. The ordinary pantograph effects reductions equally proportional in two perpendicular directions. Besides the reduction required according to the ratio of the scale of the stope plan to that of the horizontal plan, a further reduction proportional to the cosine of the angle of dip in the direction of the line of dip is necessary. The other direction to which the dip line is perpendicular is the line of strike, both lines being in the slope plane. The line of strike is taken as the axis of X and the dip line as the axis of Y.

In order to render the application of the pantographs clearer, a description of the method of reduction ordinarily used follows. Fig. 3 represents a stope plotted on the slope plane, showing the monthly contours of the stope, the triangulation system of stope points used in the determination of the face contours by offsets from a tape held taut from point to point, the line of strike *LS* of the vein (drawn through point 1652A) and the dip line *DL*. Fig. 4 represents the stope on the horizontal plane, showing the reduced contours at trimonthly intervals. A scale equivalent to 10 ft. = 1 in. is placed on the stope plan, coinciding with the dip line, zero being at 1652A. An offset scale is then moved along the edge of the first scale so that the graduated edge intersects successively the points of change on the contour of the face and pillars. The distances along the first scale and the offsets are recorded; the distances are reduced proportionally to the cosine of the angle of dip (in this case of 30° 5′) most readily by means of a traverse table to single degrees. Then on the horizontal plan a scale equivalent to 20 ft. = 1 in. is placed with divided edge coinciding with the dip line, zero being at point 1652A. An offset scale is then moved along the edge of the first

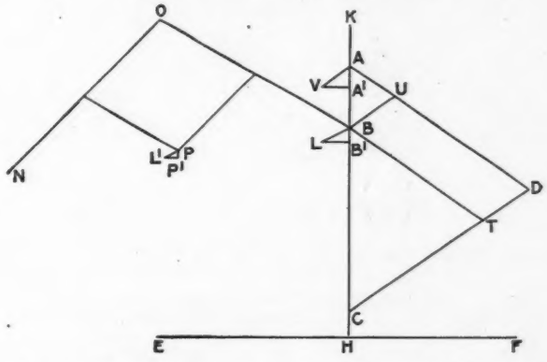

FIG. 2. BRISTOLS' METHOD OF CONTOUR REDUCTION

scale, the reduced distances and the offsets are laid off and the points connected according to the contour on the stope plan, the resulting contour being the reduced contour of the stope face and pillars. At best, when the transfers are made at quarterly intervals, the method is a laborious one.

Present Pantograph Reduction Practice

Several schemes may be adapted for reduction, all involving the use of one or two pantographs. The one that first comes to mind is to revolve the stope sheet about the line of strike as an axis until the plane of the stope sheet makes an angle with the horizontal plane equal to the angle of dip, the line of strike being parallel to the horizontal plane. Then project the contour on the horizontal plane and reduce the projection with an ordinary pantograph in the required ratio of stope plan to horizontal plan. The actual projection may be eliminated and the reduction from the inclined to the horizontal obtained direct by moving over the face contour on the slope plane a vertical tracing point fastened to an auxiliary arm attached by a parallel arm to the arm carrying the tracing point of the pantograph on the horizontal plane below, so that the upper tracing point is vertically above the lower point, which is raised from contact with the

*The author died Aug. 30, of miner's phthisis contracted during underground work in the Transvaal and on the Gold Coast of Africa.—Editor.

paper. The reducing point traces out the reduced contour.

A tentative arrangement is shown in line only in Fig. 1, which is an isometric sketch to no particular scale and not representing an actual stope. *SP* is the stope plan placed on a drawing board turned up to the angle of dip with the line of strike *LS* parallel to the edge of board and also to the horizontal plane; *UL* is the upper level; *F*, the face contour; *LL*, the lower level; *UT*, the upper tracing point; *UA*, the upper, or auxiliary arm; *GA*, the divided arc for setting the drawing board to the angle of dip *AD*; *H* is the horizontal plan; *HP*, the horizontal projection of the face contour; *WF*, the weighted fulcrum; *A A A* are arms; *LA* is the lower arm; *LT*, the lower tracing point; *R*, the reducing point; *VU*, the vertical upright to guide the auxiliary arm; *B B* are braces to vertical upright; *P* is the parallel arm arrangement of pantograph; *RP* is the final reduced stope plan on a horizontal isometric plane; *H* is a transformation of *RP* from the isometric to the rectangular, showing the face contour.

A seeming defect is that for a stope dipping 60° and with a length of back of 200 ft. the upper tracing point would have to be about 18 in. above the paper on the horizontal plane, giving rise to lateral error or else entailing a heavy cumbersome construction to insure rigidity. Some advantages are that only one pantograph is required, and the setting for the angle of dip is made directly by means of graduated arcs at the ends of the board, supporting the stope plan; whereas, other modified pantograph apparatus requires two pantographs and also that three settings of the cosine of the angle of dip be made on the auxiliary pantograph.

Seeking to evolve an apparatus that would be confined entirely to the horizontal plane, eliminating the drawing board, heavy clamps for fastening the board to the table, compact and less liable to distortion, the idea occurred to

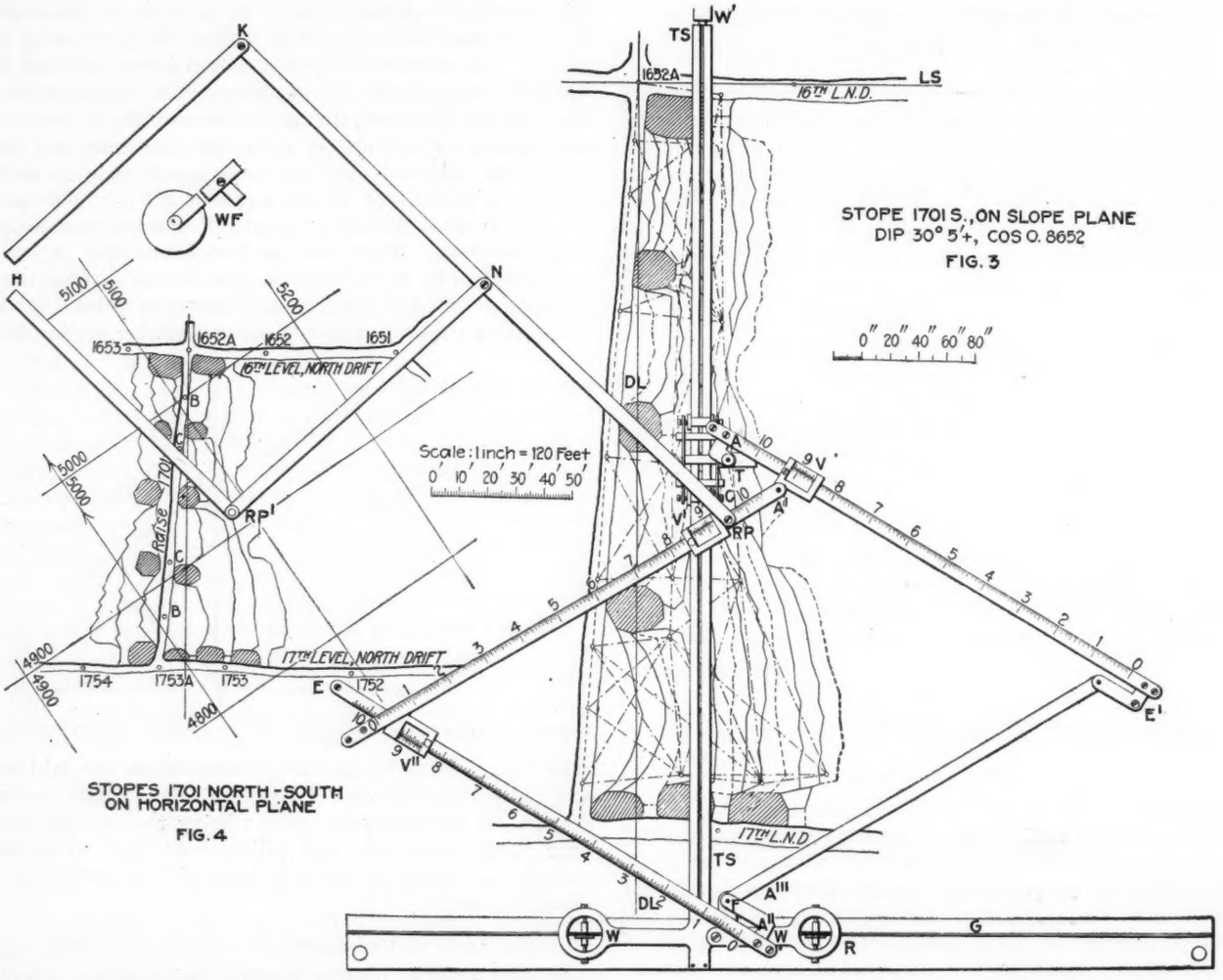

FIG. 3. SHOWING STOPE PLOTTED ON SLOPE PLANE AND FIG 4. SHOWING THE SAME STOPE PLOTTED ON THE HORIZONTAL PLANE, AND THE REDUCTION-COSINE PANTOGRAPH BY WHICH THIS IS ACCOMPLISHED

me that if an ordinary pantograph were constrained to move so that the line through the tracing point, reducing point and fulcrum moved perpendicular to a fixed straight line, with the fulcrum at a constant distance from the fixed line, in the direction of movement—that is, in the direction of the fixed line—no reduction would occur. However, in the perpendicular direction reduction would take place according to the setting of the pantograph arms. This would meet the requirements of the contour reduction. The direction of movement, or fixed line, would represent the line of strike, the perpendicular direction the line of dip and the setting of the pantograph arms the cosine of the angle of dip. Fig. 2 illus-

trates the idea graphically. *ABCD* represents a pantograph with arms set to the cosine of the angle of dip, *CT*, *TB* and *DU* representing the cosine; *A* and *B* are restricted to move along line *HK*, which moves perpendicular to the fixed line *EF*; hence *C* moves with *HK* and at a constant distance from and parallel to *EF*. As *A* is moved from *A* to *V*, *B* would move from *B* to *L*, the components of the movement of *A* perpendicular and parallel to the line of strike (represented by *EF*) being *AA'* and *A'V*; similarly *B*, *BB'* and *B'L*. *A'V* would be equal to *B'L* and *BB'* would be equal to *AA'* reduced proportionally to the cosine of the angle of dip. Similarly for an entire contour. Now if a second pantograph *ONBP* has the tracing point *B* attached to the cosine pantograph at *B*, with arms set to the ratio of stope plan to horizontal plan, then the reducing point will trace out the required reduction *PP'*. The fulcrum of the second pantograph remains fixed during the reduction, and *B* is raised from contact with the paper. If the ratio of the plans is 1 to 1, then the second pantograph is not attached to the cosine pantograph, *B* remaining in contact with the paper.

A mechanical arrangement with application to the reduction of a stope plan is illustrated in Figs. 3 and 4. *R* is a brass rail held from shifting on the paper by short needle points near the ends or by lead weights; *G* is a groove in the rail parallel to its edge, serving as a guide for the hardened steel wheels *WW* on hardened-steel spindles running in hardened-steel bearings on the short arm of the T-square *TS*. *TS* is supported at the outer end by the rolling wheel *W'*, so that *TS* can be moved easily along the rail. *TS* is perpendicular to

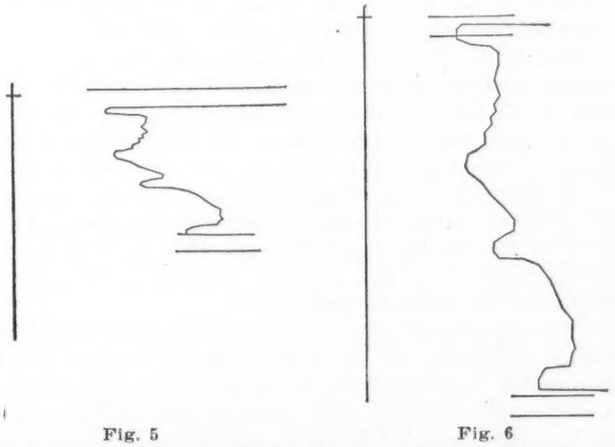

Fig. 5 Fig. 6

FIG. 5. REDUCTION FROM STOPE PLAN TO HORIZONTAL PLAN. FIG. 6. VERTICAL PROJECTION OF CONTOUR IN FIG. 4

the edge of the rail *R* as well as to the plane of the front or back faces of the steel disks of the wheels *WW*; the spindles of the wheels are parallel to the edges of *TS*. A pantograph with arms *A*, *A'*, *A"* and *A"'* has the fulcrum *F* on *TS* at *F*. Arm *A* is attached at the tracing point *T* to a frame *C* confined to and rolling on the long arm of *TS*. Arms *A*, *A'* and *A"* are graduated, the large divisions numbered from 0 to 10, each large division is divided into ten parts, each of these being subdivided into two. The verniers *V*, *V'* and *V"* are movable along arms and have nine of the last small divisions divided into ten parts, numbered from 0 to 50 by tens, so that the cosines of the angles may be set off to the fourth place of decimals by differences of 0.0005, which is sufficiently accurate for plotting purposes. Besides the support at *F* on *TS* and at *T* on *C*, the arms of the pantograph are supported at *E* and *E'* by ball rollers rolling on the paper. The frame *C* extends to the right of *T* and bears a ball roller similar to *E* and *E'* resting on the paper near the pointed end of the ivory tracing point *T*, so that as *T* is moved along the contours, it cannot scratch the stope plan. The secondary pantograph consists of four rigid metal arms, graduated with the usual tracing point attached to the cosine pantograph at *RP*.

The procedure of reduction is about as follows: The stope plan is placed on the horizontal working plan with the dip line parallel to the dip line of the stope on the working plan; the apparatus is placed with *TS* parallel to

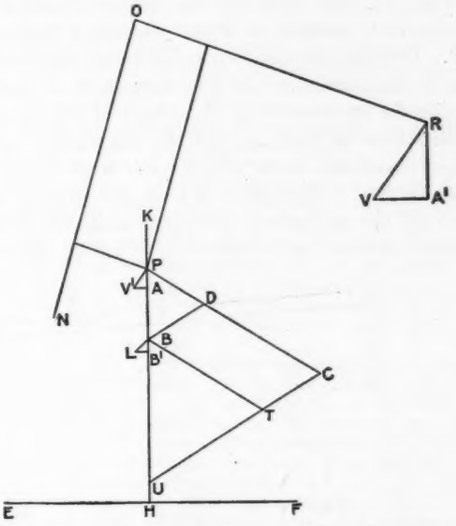

FIG. 7. REARRANGEMENT OF FIG. 2 TO PERMIT SMALLER MECHANICAL ARRANGEMENTS

the dip line, the cosine pantograph with arms set to the cosine of the angle of dip; the secondary pantograph is set to the ratio of the plans for orientation, the tracing point *T* is placed at point 1652A on stope plan, and the weighted fulcrum *WF* of the secondary pantograph is moved until *RP'* coincides with 1652A of the working plan. *T* is then moved from point to point at change of direction of the face and pillar contours.

At each point *RP'* is pressed downward, making a small dot; pressure is removed, and *RP'* is raised by a spring from contact with the paper. The points thus marked are joined, indicating the reduced contour. To protect the working plan from wear, a better procedure would be to place the apparatus in a fixed position on a separate table, making the reductions on tracing paper, transferring for orientation, position of reference point and dip line, then tracing contours on the working plan. With an assistant to do the tracing while making the reductions, the transfer is effected rapidly. If the ratio of the scales of the two plans is 3:4 or 7:8 or 1:1, this must be the method of transfer, as the reduction would not otherwise clear the stope plan.

Fig. 5 shows a reduction from stope-plan scale 10 ft. = 1 in. to a horizontal-plan scale 20 ft. = 1 in. of the last contour of Fig. 4, assuming that the dip of the stope is 80°. Fig. 6 shows the vertical projection, or reduction to the vertical plane of the last contour of Fig. 4, dip 30° 5', the roof and floor of the drives being plotted

from data of elevations. Also in Fig. 6, that part of the drawing showing face contour would be the reduction to the working plan on the assumption that the dip was 59° 55′.

Where the ratio of reduction from the stope plan to the horizontal plan is definitely established at 1:2 or 1:4 or 120:500 a rearrangement of Fig. 2, as shown in Fig. 7, is more advantageous in that the size of the mechanical apparatus, as compared with that of Fig. 4, may be materially reduced. The secondary pantograph now has the reducing point P attached to the former tracing point of the cosine pantograph at A (P of Fig. 7). B (R of Fig. 7) becomes the tracing point to be passed over the face contour. The reducing point B (of Fig. 2) of cosine pantograph remains the point B of cosine pantograph (see Fig. 7), now tracing the reduced contour on the working plan, instead of P of secondary pantograph of Fig. 2. Comparing the two procedures, one notices that in Fig. 2 the bench AV of the stope face is first reduced according to the *cosine of the angle of dip* to BL; that this reduction is then reduced by secondary pantograph in the *ratio of the stope plan to horizontal plan* to PL'; whereas in Fig. 7 the bench RV of the stope plan is first reduced by the secondary pantograph in the *ratio of the stope plan to horizontal plan* to PV', that this reduction

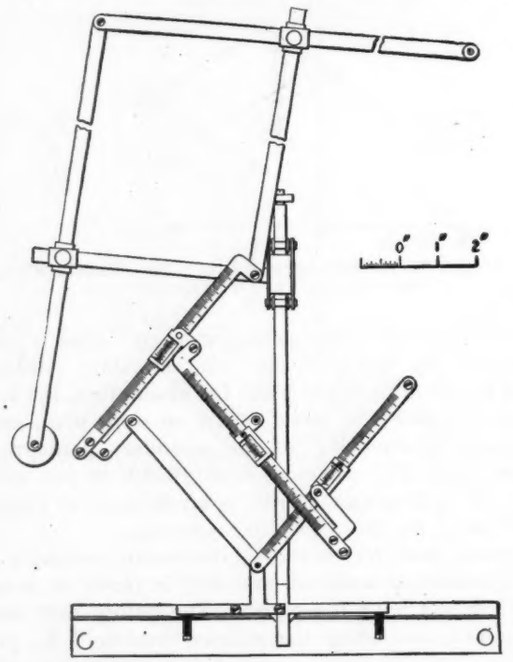

FIG. 8. COSINE-REDUCTION PANTOGRAPH

is then reduced according to the *cosine of the angle of dip* to BL.

Fig. 8 shows, according to the rearrangement, a plan of a cosine pantograph with secondary pantograph for a reduction of 1:4 (a ratio generally in use) from the stope plan to the horizontal plan. The secondary pantograph is so arranged that the arms can be set to allow for expansion or contraction of the two plans.

Among several other schemes of reduction, one that merits attention and that may be converted mechanically is that represented by Fig. 9. This apparatus effects the combination of the component of motion of the tracing point of the pantograph parallel to the line of strike reduced in the ratio of the stope plan to the horizontal plan, with the component parallel with the dip line reduced to the combined ratio of the proportions of the stope plan to the horizontal plan, with the ratio of the cosine of the angle of dip to 1, the locus of intersections of the components being the required reduced contour. Referring to the diagram, if the tracing point T of a pantograph $FDRT$ is guided over the line TL, representing a single bench of a stope-face contour, then the reducing point R will trace out RL', TL being reduced propor-

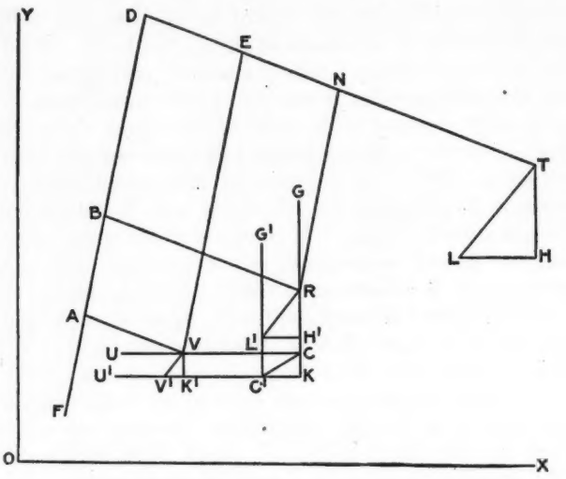

FIG. 9. COMBINATION COSINE AND SCALE PANTOGRAPH OPERATION TO GET HORIZONTAL VALUES OF ANY REQUIRED REDUCTION

tionally in the ratio of the stope plan to the horizontal plan to RL', provided the arms RN, RB, DT and DF are set to the same ratio; the component TH parallel to the dip line OY being reduced to RH' and the component HL parallel to the line of strike OX reduced to $H'L'$ in the same ratio as TL. Now if two auxiliary arms VE and VA are attached to TD and DF respectively and set to the ratio of the cosine of the angle of dip 1 multiplied by the ratio of the stope plan to the horizontal plan, then as the tracing point T is moved from T to L, V moves to V'; TL, TH, HL are reduced to VV', VK', $K'V'$ in this combined ratio.

If, at the beginning of movement of T, a square CGU is placed with edge GC in contact with V, contact being maintained throughout movement of T, with GC parallel to OY and hence CU parallel with OX, then as T is moved to L, C moves to C'; CK-VK' is TH reduced according to the combined ratio, and KC'-$H'L'$ is HL reduced according to the ratio of the plans, hence CC' is TL reduced from the slope plane to the horizontal plane. The reducing point C may be at any point on CU or CG or on any line parallel or perpendicular to CU or CG, so long as it remains fixed in reference to the intersection of CU and CG during the movement of pantograph. Orientation is secured by placing T on the stope plan at any point whose position is designated on both plans, with GC parallel to the dip line and moving the weighted fulcrum F until C corresponds to the same point on the horizontal plan. For general reductions the mechanical apparatus is impractical on account of the extreme length required for GC and UC for stopes dipping from 60° to 90° with ratio of plans from 3:4 to 1:1. For special cases, such as a ratio of 1:4 or 1:2 for dip angles from 0° to 90°, the mechanical apparatus is accurate, compact and

moves freely. Two arrangements differing only in the method of securing parallel movement of the square that I applied to the reduction of stope shown in Fig. 4 gave precisely the same contours as shown in Fig. 3.

Apparatus based on principles similar to those illustrated in Fig. 1 costs on the Rand, £60 ($292), while the arrangement in Figs. 8 and 4, ordinary pantograph included, should not cost above £12 and £15 in Europe during normal times. If the office equipment includes a pantograph, then for the cost of the general cosine pantograph of Fig. 4, £10 would be ample, while for the special pantograph, £7 would suffice.

Safety First at Omaha

For the last six months there has been such a remarkably low accident record at the Omaha plant of the American Smelting and Refining Co. that it can no longer be regarded as a "flash in the pan," but must be attributed to the excellent work of the management and the men themselves, says the *Safety Review* of the American Smelting and Refining Co. The manager of this plant, Walter T. Page, gives the following interesting description of the method used for securing these results:

In the chasing down of accidents and the very great reduction of same at this plant, the following method in outline has been adopted:

In the first place, the personnel of the plants is divided up into three committees, made up of the workmen of the various departments. The numbers are divided up as nearly equal as possible, and they are made up also with reference to exposure to accidents, so that they are as nearly as possible all on the same plant. Each of these committees has a flag, and the committee which has had the least number of accidents in any one month has its flag at the masthead as a recognition of its good services.

Next, we have a rule book. This rule book is a good one. It was made up by the superintendents' committee and also the foremen, and was subject to much discussion pro and con before it was published; in fact, it is the result of the best thought of the experts in the whole plant to avoid accidents in every department.

We may say in passing that this rule book is printed in four or five different languages to suit each employee as the case may be. Each man is given one of these little books and is required to learn the general rules and also the special rules of his department. The superintendents, when they have the time, instruct them, and the foremen likewise. After they have progressed to a certain point as individuals they give them an examination, and if they pass that examination they are given fobs to wear. The fob is a sort of a bronze affair hung with a little leather strap. It makes a very good watch fob and is rather sightly in appearance. The men vie with one another to get these mementoes and work hard for them. The task is not difficult, and it all stimulates each department to become familiar not only with their work, but with the dangerous practices connected with it.

If a man meets with an accident violating a rule, it goes hard with him. The men themselves will take him in hand, and the foreman will do likewise. Immediately after each accident a meeting is held, bringing together all the witnesses, and the responsibility is placed, it matters not on whom it may fall, and the decision reached is placed on all the blackboards in the plant. The greatest publicity is given to all matters pertaining to safety, and on entering the plant the first thing that greets the eyes of the workmen is a great blackboard on which any recent information is published. Blackboards are furnished to each department, and these are scanned daily by the men in that department.

Near the gate is a target with a red bull's-eye and for each accident the ball is moved out from the center one division.

If any department has made an especially good record, it is recognized on the larger bulletin board as well as the one in that department.

So much for the real prevention of accidents. Aside from the above committees, there is a superintendents' committee and the general foremen's committee. Each of these committees meets every two weeks. All the accidents are gone over and discussed and recommendations come in from both as to any improvement that might be made in the plant to make it a little safer. Suggestions from the foremen's committee are passed on to the superintendents for action, and wherever it is feasible and desirable, their recommendations are agreed to and the change requested is made.

We encourage suggestions from the men and the foremen, and wherever there is sufficient merit they are concurred in and a remedy applied. We find that doing this makes the men and also the foremen feel that they have a voice in the operating of the plant for safety purposes, and it increases their interest correspondingly.

We have spent a good deal of money in placing safety devices. Very many of them are excellent, but we believe that the greatest amount of good has come not from these expenditures, but from inculcating the safety habit in the man employed as soon as he is enrolled on our books. Immediately he is given the Rule Book with the injunction that he is to become a safety man from that time forward—that he is to safeguard others as well as himself, and is told that careless men are discharged as soon as their habits become apparent.

We have a physician who comes to the plant at 10 o'clock every morning and remains one hour or more. He makes a physical examination of all the men newly employed in the last 24 hours with a view to their desirability. Some are rejected immediately, but most of them are retained. The doctor being in the plant enables the old men who are in any way ailing to reach him with the least amount of difficulty on their part, rather than have them go to his uptown office, which is not so accessible. It is optional with them, however, as to which place they may see him.

One of the real difficulties which we encountered was to have the foremen or mechanical men in charge slow their work down to a point where their operations were conducted in a safe manner. There is always a tendency to push the job along. That is almost invariably one of the elements which we have in operating, and when the limit at which the men can move safely and securely is exceeded, you are going to have bad accidents. This was a difficult point to overcome, but I believe it has been overcome by continued and energetic effort and warnings.

One more point: We do not believe generally in bonuses and premiums in welfare work, but in one respect we have diverged a little from this. We give cigars to the departments that have gone through the month without accident. The cost is not great, and the benefit has been real. It makes a little distinction between those who have been careful and those who have allowed accidents to creep in.

In concluding I must add that the methods outlined are good, and that our safety and welfare man, Mr. Rasmussen, who is simply a bunch of enthusiasm in himself, has the happy faculty of imparting this enthusiasm to others, and is in this way largely responsible for our obtaining the results which show for themselves.

Discovery of the Miami Mine

The story of the discovery of the Miami has been told with an increasing number of fancies as the years have gone by, and irresponsible itinerants have given free rein to their imaginations. The true account of the find, as vouched for by a well-known engineer, is as follows:

The red iron-stained hills of what is now Miami had been known for many years in the Globe district before anyone considered them worth locating. Late in 1906, however, Fred Alsdorf, then a young mining engineer, was attracted by the possibilities of discovery on the property and took an option to purchase. A few evenings later, Mr. Alsdorf met J. Parke Channing, consulting engineer for the General Development Co., and interested him to the point of taking an option on the property for his company. Incidentally Mr. Channing looked at the Inspiration property at about the same time, but was more favorably impressed with the showing on what later became the Miami.

Aggressive development work started, but ore was slow in showing up. At a depth of 190 ft. in the Red Rock shaft, the bottom was still in the leached zone. At this point Mr. Channing was called to New York and left the sinking in charge of Mr. Alsdorf. The latter continued sinking 20 ft. more and struck the orebody that made the Miami mine.

Details of Practical Mining

The Granby Mine Car

By C. M. Campbell*

The Granby company began shipping from its Phœnix mines in 1900. At that time the recovery was 31 lb. copper and $2.25 in gold and silver. In 1905 the shipments amounted to over 500,000 tons and the recovery had decreased to 24 lb. copper and $1.30 in gold and

THE 75-FT. GRANBY MINE CAR

silver. This reduction in grade and the necessity for further reduction in order to include additional material in the reserves made a minimum mining cost imperative. During the five-year period referred to the cost of ore on cars was, therefore, brought down from $2 a ton to $1.14 and since then has been as low as $0.66.

During this period the haulage system has been entirely reconstructed. Electric motors running on a 3-ft. gage track with heavy rails and easy curves were introduced. Hopper-bottomed cars with a 10-ton capacity seemed to be the best at that time on the market, and this type was introduced. While a great improvement and very satisfactory when the ore was small, it was found that, as the bulk of the ore was coarse, the contents often had to be blasted out of the cars. This caused loss of time, extra cost for powder and labor and a heavy car-repair expense. For some time the possibility of an automatic side-dumping car had been under consideration, and in 1905 (when A. B. W. Hodges was local manager, O. B. Smith, mine superintendent, and F. J. Knott, mechanical draftsman), the type of car shown in the illustration was designed and 20 of them were put into commission. These cars, having a capacity of 95 cu.ft. each, have given satisfaction, the original installation being still in operation. The nature of the cars and of the dumping operation can be seen from the illustration. The motor goes ahead at slackened speed, and each car automatically dumps as the wheel on the box climbs the incline.

In later years various modifications of this car have been constructed. A smaller type, having a capacity of 75 cu.ft. has been used extensively. These cars operate on two levels where the gage of the track is 20 in. They are equipped with M. C. B. couplers and roller bearings. They all dump at an angle of 30°. This incline is satisfactory for Phœnix ores, which are coarse and comparatively dry. When the ore contains a proportion of fine, damp material, this incline is not steep enough. For this reason the cars recently constructed here for the Anyox mine, where a portion of the ore is fine and sticky, were built so that the incline of the box when dumping would be 45°. These cars, having a capacity of 135 cu.ft., also have a simplified leverage arrangement for opening the door, and as the door swings free, the opening will pass a rock 4 ft. in diameter.

*Superintendent, Granby Consolidated Mining, Smelting and Power Co., Phoenix, B. C.

Spring-Steel Prospecting Bit

By Sydney H. Ball* and L. S. Thompson†

In the southwest Virgina lead and zinc field the oxidized zinc orebodies are prospected by means of a light, spring-steel core drill. The cutting shoe of the drill, shown in Fig. 1, consists of a split steel ring 6 in. in

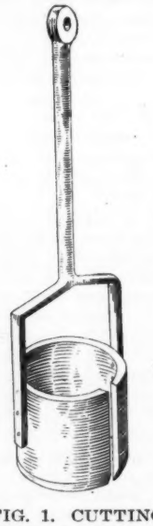

FIG. 1. CUTTING SHOE OF DRILL

FIG. 2. DRILLING BY MAN-POWER

diameter, beveled so as to make a cutting shoe and supported by a steel stirrup. The shoe weighs about 30 lb. and is operated as a percussion drill, being pulled about

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every 6 in. (the height of the ring) and cleaned of its core of clay or oxidized zinc ores.

As usually operated, the shoe is slung from a 1-in. rope passed over a sheave mounted on a tripod, as shown in Fig. 2. Two men are employed on the rope to lift the bit, while a third stands at the hole to rotate the rope, direct the blows and throw the bit downward—as it is too light to work by gravity alone—and to clean the bit. From 40 to 50 ft. are drilled per day of 10 hr., the drilling costs, exclusive of fixed charges and re-sharpening being about 7c. per ft. The whole outfit, including tripod, rope and shoe, weighs from 150 to 200 lb. and is readily set up at a new location.

At the Ivanhoe Furnace Co.'s property at Ivanhoe, Va., Charles Huddle improved the drill by attaching a 2-hp.

FIG. 3. IVANHOE FURNACE CO. PROSPECTING DRILL

gasoline motor to a hoisting drum by a slack belt provided with a tightening pulley, as shown in Fig. 3. One man directs the blows, and a second operates the tightening pulley, hoisting and releasing the shoe. The mobility is increased by mounting the engine and head gear on a truck. This machine is claimed to drill 150 ft. or more per day at a somewhat less cost than with the hand type. The capacity may later be increased by the use of a 100-lb. bit and by replacing the driving mechanism with a friction clutch. Further, the machine may be made self-propelling by putting a chain drive on the truck.

This type of drill has proved to be efficient and economical in prospecting the sticky clays that overlie the oxidized zinc ores in this region. It is only satisfactory for prospecting plastic materials, permitting the retention of a satisfactory core in the annular piece of steel. As a cheap drill, however, to prospect for oxidized zinc ores, brown-iron orebodies and kaolin deposits, and sometimes to spud for diamond drilling, it has considerable merit.

Motor Would Not Start

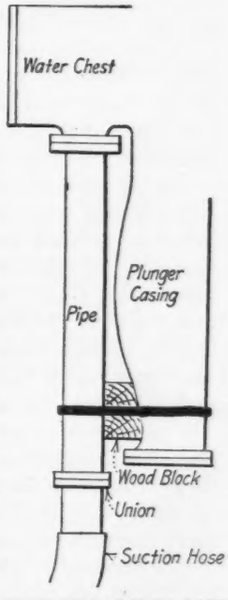
The failure of a continuous-current motor to start is usually due to one of several conditions, among which are the following, according to E. C. Parham, in *Power* Dec. 12, 1916: A dead line, an open-circuit, a short-circuit, a ground, low voltage and an overload. In case of a dead line or an open-circuit, unless the open-circuit happens to involve the shunt-field winding, there will be no sign of a flash when the starter is thrown on and off. In the case of low voltage, short-circuit, ground or of overload, however, there will be a flash when the starter is thrown on and off. In all cases except that in which failure to start is due to an excessive load, the trouble may be readily located by checking the connections and by testing the voltage and the insulation. The condition of overload in starting usually is not so easy to determine unless the motor is also found to be overloaded when running. Occasionally local conditions like the following suggest the cause of the failure to start.

A direct-current motor, which was used for the pumping of water and which was controlled by means of an automatic controller that was adjusted to close the motor circuit when the water pressure reached a minimum of 40 lb. and to open the circuit at a maximum of about 60 lb., was complained of because it would not start. Troubles as reported often need qualification, and in this particular case "would not start" meant that the operator had left the motor running all right one night and the next morning found the pressure well below the starting value, the motor stopped and apparently was unable to start. An inspector found that the apparent inability to start was due to a fuse having blown. On replacing the fuse, the motor started all right and promptly pumped up the pressure; but the pressure switch failed to operate even when the pressure had reached 75 lb. Above this pressure the decrease in the motor speed was plainly evident, and a grinding noise emitted by the motor indicated overload conditions; had the motor been permitted to continue to run, the fuses would have blown.

The whole trouble was due to the fact that someone had been tampering with the pressure-switch adjustment and had raised the cutting-out pressure to a value that overloaded the motor and caused its fuses to blow before the pressure could reach the value at which the switch would act.

Steadying the Suction Pipe

The device illustrated herewith is for use on sinking pumps, and though it may be quite contrary to common practice, I have found it useful on a number of troublous occasions, says J. F. K. Brown in a recent contribution to *Coal Age*. In sinking it has always been my custom to use a length of pipe at the suction which will reach just below the bottom of the pump, and to attach the hose at this point with a union. This has been done because there is little room between the body of the pump and the pipe in which to place a union and to take off and put on the hose. It is easier doing it just below the pump. When this pipe was first used it caused trouble by frequently breaking off where it entered the pump, because of being knocked against the sides of the shaft in raising or lowering. To obviate this a piece of wood is now inserted as shown in the drawing. This has the effect of making this piece of pipe solid with the pump throughout its entire length. Breakage of this pipe is now rendered infrequent as the pipe is thoroughly steadied by the block and cannot vibrate.



THE STEADY BLOCK IN PLACE

Details of Milling and Smelting

Launder Flotation Machine

By B. M. Snyder*

The flotation machine described in this article is of the pneumatic type. It consists essentially of a series of short and flat launders placed side by side and connected by pipes or bypasses, each launder or cell having a separate air-box, or distributor, covered with canvas, for aëration of the pulp. It was designed in May, 1915, by George Crerar, who was experienced in the use of Callow machines, and it has been in successful operation during the year.

The launders, or cells (of which there are six in the machine as modified), are 14 in. wide and 6 ft. in length, each cell discharging at the end into the next cell in series, giving a travel for the pulp of 36 ft. The effect is the same as if the pulp were run through a straight launder (with baffles in it 6 ft. apart), but the construction is obviously improved by division of the launder into sections placed side by side. There is a drop of 3 in. from cell to cell, but each cell is flat-bottomed. The flat bottom permits an even distribution of air to the cell, as the depth of pulp and therefore the pressure is the same at every point. Each cell has its own air distributor, controlled by a globe valve. The drop of 3 in. from cell to cell provides sufficient hydraulic head to keep the pulp moving freely, and the greater depth of cell at the discharge makes it less easy to pull over gangue as the pulp becomes impoverished in mineral.

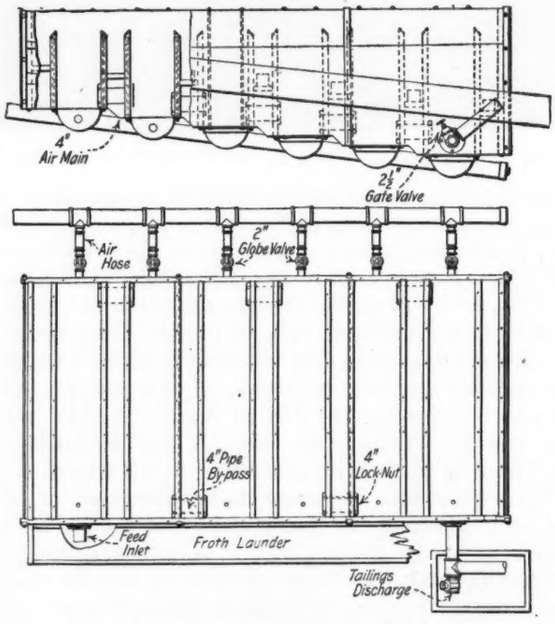
The narrow cells with froth launders on both sides facilitate overflow of froth, the maximum horizontal travel of bubbles being only 7¼ in. The froth launders are flat and are allowed to fill with concentrates and make their own slope to the main launder outside the machine proper. Water sprays are used in the launders if the persistence of the froth makes it necessary. The most effective spray is that produced by a single small stream of water shot down the slope of each launder under a good pressure.

The porous medium used has been 14- or 16-oz. canvas, 4-ply, sewed 1 in. centers both ways, being practically the same as used in Callow cells. They ordinarily last about six months before "blubbing" badly. The canvas bottoms are simply stretched and tacked while dry to the under side of the wooden cells, and the steel pans bolted tightly against them. No wire screens are used above the canvas, since the latter shows little tendency to bulge under pressure of air, on account of the narrow span. The air pressure required varies from 3 to 5 lb. per sq.in.; and is best supplied by a cycloidal blower designed for 6 lb. pressure. In the first machine built, porous bricks 1½ in. thick were tried, but on account of variations in porosity, were soon discarded.

The first cells built had sheet-iron baffles spaced 3 in. apart and reaching to within one or two inches of the canvas bottoms. These were intended to confine the travel of the pulp to a narrow space at the bottom of the cell and thus prevent the banking of sand, but in practice they were not found necessary and in later installations have been dispensed with.

The depth of pulp in the cells is usually maintained at about 12 to 24 in. in the deepest cell, the cleanest concentrates being made with a low pulp level. In the first machine the pulp level was maintained by float valves, but the simpler method shown in the accompanying drawing has been tried and found satisfactory. The gate valve is closed just enough to give an overflow in the standpipe, which can be raised or lowered by turning the tee. The gate valve passes heavy sand, and the overflow takes care of any excess of pulp. A series of drilled plugs could be used in place of the gate valve, or a valve similar in design to a molasses gate might be used to advantage.

The air distributors are simply air-tight steel pans bolted to the bottom of the wood cells and connected to the air main by 2-in. pipes and air hose, the latter suggested by J. C. Draper as a substitute for unions. The steel pans are not removed except for replacing canvas blankets, which ordinarily last about six months.



THE LAUNDER FLOTATION MACHINE

The control of air is effected by globe valves, which are conveniently placed at the ends of the air distributors. The operating platform is at the same height as the valves, and the operator walks along the line of cells, turning the valves with his foot, until the right overflow of froth is obtained.

As indicating the work the machine will do under proper conditions, the following results obtained in a typical ten days' run, are given: About 60 tons of ore was treated daily in one machine of the type described. The ore was crushed to pass 99.5% through 60-mesh and 94% through 100-mesh. Concentrates were recleaned in a

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2-cell machine and then tabled for separation of lead-iron concentrates. The ore was low-grade blende carrying pyrite and a little galena in a gangue of quartz and siderite. Carbonate zinc was present to the amount of 0.2%. The oils used amounted to 1.4 lb. per ton of ore, of a mixture of 70% coal-tar creosote and 30% refined pine oil, added at the ball mill. Acid to the amount of 7 lb. per ton of ore was also added.

ASSAYS OF HEADS AND TAILINGS IN TEN DAYS' RUN

Date	Flotation Heads, % Zinc	Flotation Tailings, % Zinc	Concentrates, % Zinc
July 22	4.3	1.00	49.8
July 23	4.0	0.64	48.1
July 24	3.9	0.71	48.0
July 25	4.0	0.61	48.7
July 26	4.1	0.56	49.0
July 27	4.3	0.51	46.3
July 28	4.4	0.41	45.4
July 29	4.5	0.51	41.1
July 30	4.3	0.40	39.3
July 31	4.8	0.56	44.2
Average	4.26	0.592	45.99

Extraction of zinc by flotation..... 87.3%
Extraction of sulphide zinc by flotation..... 92.0%

In another plant the extraction by flotation in a similar run was 92.8% of the total zinc in the flotation heads, which averaged 13.2% zinc.

The machine is simple in construction and, except for the air distributors, can be constructed and erected complete in one or two weeks' time by any good carpenter or millwright. The air distributors are of simple design and can be made by any boiler maker, though to prevent air

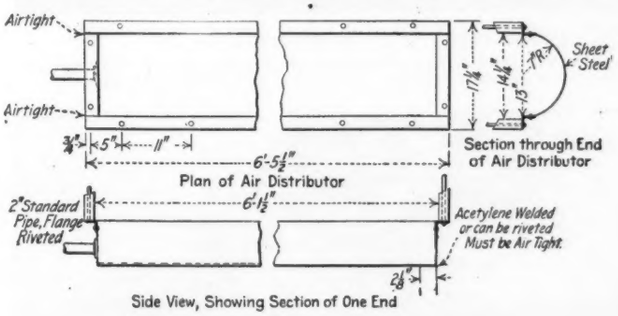

Airtight
Airtight
Sheet Steel
Section through End of Air Distributor
Plan of Air Distributor
2" Standard Pipe, Flange Riveted
Acetylene Welded or can be riveted Must be Air Tight
Side View, Showing Section of One End

DIAGRAM OF THE AIR DISTRIBUTOR

leaks it is best to have them made at a boiler shop equipped to weld joints by acetylene flame. The cost of a machine erected complete was as follows:

COST OF THE FLOTATION MACHINE

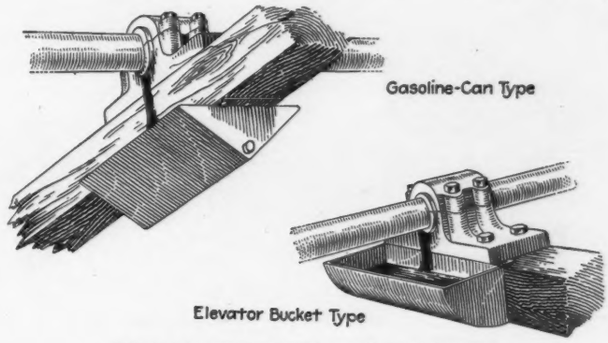
Tank lumber (tongued and grooved)	$31.15
Air distributors (made to order at boiler-shop)	113.72
Pipe fittings and iron rods for bolts (estimated)	116.00
Hauling material	15.00
Blacksmith labor on bolts (estimated)	18.00
Labor, carpenter and pipemen	164.25
	$458.12

The labor required to attend to the regulation of the cells is small; one man should easily look after six or eight machines under normal running conditions. The air valves do not require frequent changes, if feed, oil and air supply are regular. Regularity of feed (both as regards percentage of solids in pulp and its regular flow), regularity of oil and air supply, a constant pulp level in the cells and regular attendance will insure good results, once the matter of the proper "dope" to use has been determined.

The air required is seldom more than 10 cu.ft. of free air per minute per square foot of frothing area, and the power consumption under usual pressure (3 to 5 lb. per sq.in.) will not exceed 0.2 hp. per sq.ft. of frothing area. The air consumption of course varies considerably, according to the frothing character of the ore and oil mixture, whether ephemeral or persistent, etc. The capacity of the cells also varies widely with conditions. In one case 250 lb. of mineral was lifted daily per square foot of rougher frothing area, and this can be taken as a fair average.

Shaft Oil-Drip Receptacles

The illustration from a recent contribution to *Power* by A. C. Daman, shows two lineshaft oil-drip receptacles, cheap, serviceable and homemade. Of the two the



TWO EASILY MADE OIL CATCHERS

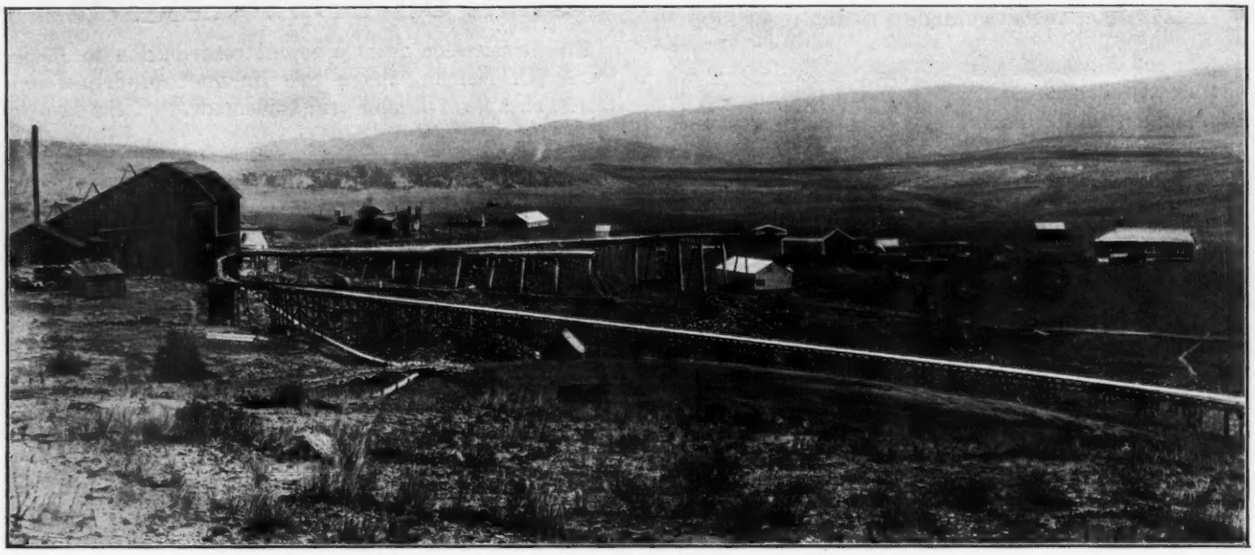
oil-can type, made out of half a five-gallon oil can nailed to the bottom of the timber directly under the line-shaft bearings, is the cheaper. Use is made of the spout to draw off the oil when necessary. The bucket type is easily made where old discarded elevator buckets are obtainable. The oil that accumulates is dipped out and put through a filter.

Protecting the Gas Ports of Openhearth Furnaces

In order to overcome the rapid deterioration of the gas nozzles of openhearth furnaces, caused by the action of the intensely hot outflowing gases, rendering the furnace unfit for use until repaired, says *Iron Age,* Nov. 30, 1916, James W. Barnes, Youngstown, Ohio, has provided a mechanism (U. S. Patent 1,186,370) whereby communication between each gas nozzle and its gas chamber is cut off at the outflow end of the furnace so that the hot products of combustion will pass from the furnace solely through the air outlets. An arrangement of ports and valves is also provided by means of which the gas nozzle at the supply end will be placed in communication with its gas chamber simultaneously with the cutting off of communication between the other gas nozzle and its gas chamber.

Mining in British Guiana, according to United States Consul George E. Chamberlin, of Georgetown, yielded 53,907 oz. gold valued at $935,786 in 1915, as compared with 63,425 oz. valued at $1,106,783 in 1914. About one-fifth was secured by dredging and the remainder by placer washing. The total output of diamonds was 6,203 carats valued at $51,390, as compared with 9,705 carats valued at $87,196 for 1914. Bauxite deposits are known to exist, but have not yet been developed. Some 13,000 acres of private lands have been purchased, but negotiations for Crown lands have been delayed on account of the European War. In the northwest district the finding of oil has been reported. Applications for exploration licenses have been made, but no satisfactory results have been obtained. Drilling is being carried on by only one party.

Photographs from the Field



PLANT OF THE YOGO SAPPHIRE MINES IN FERGUS COUNTY, MONTANA

Fergus County, Montana, is said to be the only locality in the world where sapphires are profitably mined "in place," all other production coming from placers. The principal American deposit is now owned by a British company

WHERE SOME OF THE COPPER AND ZINC HAS GONE

Cartridge cases from ammunition expended by 75-mm. guns "somewhere behind the trenches"

A COMPLETE MANGANESE MINING AND MILLING PLANT AT CARTERSVILLE, GA.
Openpit in foreground; in center, the log washer, power plant and the product of a season's operation

NOT A BATTLEFIELD SCENE—MERELY A TOO-AMBITIOUS ATTEMPT AT MANGANESE MINING IN GEORGIA

Correspondence and Discussion

Labor Conditions

A constant reader of the invaluable *Engineering and Mining Journal* for many years, I cannot agree with its views on the labor situation, as indicated partly by the reproduction in the issue of Aug. 12 of a paragraph from a circular published by the National City Bank, and partly by the *Journal's* comment thereon.

I have been a life-long student of labor, of the relations of the employer and the employee to each other, of their attitudes toward each other and toward the public, and of the attitude of the public toward them and their several problems. I have done this not as a student merely nor as an idealist, but as one actually employed and responsible for the employment of many thousands of others, as worker, timekeeper, foreman, contractor, superintendent, manager and owner, and feel that I can speak of this matter from a practical standpoint.

Without going into an analysis of the subject, which limitations of space would forbid, I concur with the opinion that there certainly is an "alarming increase in the inefficiency of labor" if we think only of the shiftless or "I. W. W." class among laborers. And this is really surprising, in view of the general progress of the workers. Then, too, there is a large number of employers who, in the handling of their labor, certainly must be classed as "inefficient." This is still more surprising in view of the great activity in recent years of efficiency and other industrial students. Much valuable knowledge has been obtained and printed on this most important topic, but as yet it has reached a very small percentage of our people. To this must be attributed this class of "inefficient" employers to whom we refer. A few of their greatest sins against efficiency are:

1. Some pay their men by the day, varying the rates according to the *class* of work rather than according to *class and amount* of work performed.

2. Some pay on contract or piecework basis, placing a limit, beyond which they refuse to go.

3. Some pay on contract or piecework basis, cutting the rates when men show their ability to earn more than the maximum allowed.

4. Some, when men on contract demonstrate their ability to produce much more than before, return to day-work, expecting to compel like efforts by the men.

5. Some, when on contract basis, charge exorbitant and fictitious prices for supplies.

6. Some, like the considerate and sympathetic employer referred to by the bank mentioned, pay an unusually high rate per day when business is good, with results almost invariably in line with those noted in the circular.

7. Some do not classify labor charges or keep close "tab" on labor costs.

8. Some do not make any effort to provide attractive quarters or surroundings for their employees.

9. Some who do, seem to think that these advantages should be accepted in lieu of better rates.

10. Some do not seem to realize the actual interdependence of the employer and employee classes.

Without wishing to criticize, I feel that the employer is under obligation to himself, his fellows, his workmen and the public, to study and acquaint himself with the results of various methods and systems of employment; and this obligation, by the way, extends also, in a measure, to engineering journals and to the leading magazines and industrial students of the country. Of course our labor and other governmental departments should make this whole problem an open book to the public, but the pernicious influence of the politician and the professional agitator will probably prevent this.

As an example of what I believe is a very general lack of information on the merits of different systems of employment, I cite the experience of a small corporation here, which for the last 15 years has employed a large number of men and almost invariably on the day-wage basis.

About six months ago laborers were very scarce, wages were high, the product was small, efficiency was low, markets for the product were active and prices soaring, and the little community was in the dumps. Something had to be done. A proposal to change to a contract and bonus system found company and men very skeptical, some dreading disaster in one direction and some in another. A few men were persuaded to give it a trial, and soon a very salutary change was effected.

As a result several men have more than tripled their earnings, about half had their wages doubled, others have added 50 to 75 per cent. to their daily earnings, and the average of all the rates has been raised approximately 50%, purely on an efficiency basis.

In the meantime the product has increased 400%, men have been attracted from outside, the property and community values have gone "skyrocketing," the profits, we are assured, are very gratifying, while unit costs have been lowered decidedly and everybody "wears a smile." There is an air of partnership and prosperity about the place, and the walking delegates have all left us.

The explanation seems to be that even in the best of times men can be found who are able, anxious and willing to do several times the ordinary day's work, but they are men of ambition who expect extra remuneration for doing it. What could be more like human nature?

The problems then, seem to be to reach such men, to conclude a satisfactory agreement with them, to be absolutely frank and fair and to ask and expect them to "hit the ball." In this case the contract and bonus system has effected the solution of the problem.

H. F. ELLARD,
Superintendent, Pittsburg-Idaho Co., Ltd.
Gilmore, Idaho, Nov. 25, 1916.

[We concur in principle with all that Mr. Ellard has said and point out to him that it is not in conflict with the opinions expressed in the editorial to which he refers. He is fortunately able to report some experiences different from what were summarized in our article. In offering a generalization nobody, of course, excludes possibilities of exceptions.—Editor.]

The Huayni-Potosi Bismuth-Tin Mines of Bolivia

By Benjamin LeRoy Miller* and Joseph T. Singewald, Jr.†

SYNOPSIS—District is distinct from Potosi, the name being due to similarity of deposits. Spaniards worked oxidized silver ores and ignored tin. Bismuth discovered later and, with tin, now chiefly sought. Zinc present, but transportation cost is prohibitive. In one group well-defined veins occur in shattered zones. In the other group vein-system is less definite. Mining methods are crude and output is small. Work consists principally of development. Ores generally stamped to 16-mesh, classified or screened, and concentrated on tables, etc. Ores or concentrates containing over 5% bismuth are shipped without further treatment. Tin concentrates, shipped as "barrilla," carry about 65% tin.

The traveler passing over the great altiplain of Northern Bolivia or crossing Lake Titicaca has his attention repeatedly called to three beautiful snow-capped mountains rising above the general elevation of the Eastern Andes, or Cordillera Real. These are Illampu (Sorata), Huayni-Potosi, and Illimani, the three highest and most impressive mountains of Bolivia, each over 20,000 ft. in height. At the base of these mountains much mining has been done during the last three centuries, and yet these revived mines are still producing considerable mineral wealth and may even exceed their former records when the mines now in operation are properly developed and equipped. Near Illampu and Illimani the gold deposits have attracted the most attention; while the mineral deposits of Huayni-Potosi are mainly silver, tin and bismuth, with subordinate amounts of gold and wolframite.

The mountain of Huayni-Potosi lies east of the southern end of Lake Titicaca and about 30 km. north of La Paz. Near the base of the mountain silver was discovered by the Spaniards, after the rich silver mines of Potosi had been opened; and as the deposits of the two places seemed to be similar, the new region received the name of Huayni-Potosi, which in the Quichua language means "young Potosi." Potosi itself means "thunder" and was so named because of the frequent great electrical displays seen there.

The Spaniards worked the oxidized silver ores, the *llampus,* but evidently did not do much mining after the sulphide zone was reached. About 20 years ago, when the tin deposits of Bolivia began to attract attention, the possibilities of Huayni-Potosi were investigated and the mines reopened for tin ores, the materials ignored by the silver miners. In some of the mines bismuth was later discovered, and the ores of these two metals are the ones now sought. Some gold and tungsten deposits have been investigated, but so far have not been actively worked. There is also considerable sphalerite, but, as is true all through the Andean mining districts, zinc ores have

THE GLACIERS OF MT. HUAYNI-POTOSI FROM THE CARMEN MINE, BOLIVIA

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received little attention, as the cost of transportation of these ores has been prohibitive; therefore little information is available in regard to the character and amount of these ores.

The mines of Huayni-Potosi are not reached by the railroad, consequently all supplies must be brought in from La Paz or from the branch line that runs from Viacha to Guaqui on the southern end of Lake Titicaca. Llamas are used almost exclusively, as they are better adapted to the high-altitude conditions than any other animals. The mines are chiefly in two groups several kilometers apart—at Milluni and near the Union Mill, where the Carmen mine is the most important one. The operating mines are owned by the Huet Hermanos, Frenchmen who have long lived in Bolivia.

Leaving La Paz on muleback, at 8:30 a.m. on a June morning, we ascended the steep slopes of the great gorge, 1,500 ft. in height, and emerged on the extensive altiplain formed by the alluvial gravels and sands brought by rivers and glaciers from the nearby mountains. Heaps of cobbles scattered over the surface, picked from the surface soil by the Indians, who here raise their scant crops of barley and potatoes, could be seen on every side, while in places the soil was being prepared for the next crop. As we proceeded, the country became gradually higher and the irregularities greater, and a strong, cold wind blowing from banks of snow and ice thoroughly chilled us even though we were well within the tropics. About noon we reached the highest point on the route, over 15,000 ft. above sea-level, and then followed a trail down into a valley where the Milluni mines and mill are situated. The mill and small settlement are at an elevation of over 14,000 ft., while the mine openings are at various places on the steep slopes up to 15,000 ft. or even more. From the mines and settlement the great glaciers and ice cascades of Huayni-Potosi Mountain are most beautiful, yet the cold blasts that blow from them are not so pleasant. Fuel is too scarce for use in heating the houses, so when night comes on it is necessary to wear heavy overcoats, and notwithstanding the extreme attention given to social form and etiquette in the Latin-American countries, comfort demands that hats and overcoats be worn in the house, even during the meals.

Geology of the Milluni Mines

The country rocks of the Huayni-Potosi region consist of black arenaceous slates, micaceous sandstones and gray quartzites of Devonian age, into which have been intruded many dikes of quartz-porphyry and other closely related rocks. The sedimentary strata rest upon a large mass of granite, which is exposed a few kilometers distant. The slates and quartzites strike approximately north-south, dipping to the west at various angles from 5° to 50°.

The veins occur in shattered zones that approximately conform in strike with that of the inclosing slates and quartzites, but in general dipping to the east at high angles instead of west as do the rock strata. In some cases the veins are true fissure veins, but in the main consist of stringers of ore within shattered rock.

The veins at Milluni differ from those near Union Mill by the absence of bismuth. Mineralogically or structurally, four distinct types of veins are recognized, as follows:

1. Quartz-pyrite veins carrying cassiterite in very fine grains. Near the surface these veins have been oxidized, forming a gossan that carries fairly high values in tin or, where quartz predominates, a rusty mass of porous quartz containing small druses of quartz or cassiterite crystals. This is the most common type of vein and is represented by the Concepción, Salvadora and Coquelin veins.

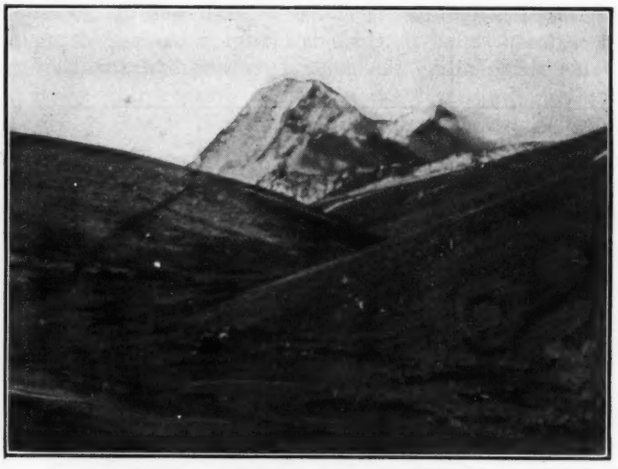
2. Sphalerite veins containing siderite, quartz and small quantities of cassiterite, and carrying considerable silver. These veins are mainly fissure veins and show prominent banding. Veins of this kind, represented by the Roche vein, are not extensively worked at present.

3. Brecciated quartz-pyrite-cassiterite veins cutting across the bedding planes of the quartzites, with occasional stringers of rich ore developed along the bedding planes adjacent to the shattered zone. These veins are variable in both width and values.

4. A quartz-pyrite vein, no longer worked, which contained some uraninite. Much silver ore was taken from this vein by the early Spaniards.

Mining and Milling at Milluni

When the European War broke out, one of the Huet brothers, owners of the mines, went back to France to serve in the French army and the operations of the mines were considerably curtailed. We visited a number of places where ore was being removed, in some cases in



DISTANT VIEW OF MT. HUAYNI-POTOSI

opencuts, but in most places through adits run into the side of the mountain. Some stoping is done, although most of the ore is obtained in driving the adits on the veins with the intention of later opening up stopes where the ore is most promising.

All mining is done by hand with chisels and hammers. The ore is thrown into cars in the main drifts, but elsewhere is put into raw-hide bags, which Indian women and boys carry to the cars. On the steep mountain sides far above the mill the ore is put in large rawhide pouches that are let down by cable to the tracks that run to the mill. From the highest mine openings the ore is handled three times before it finally reaches the mill. While the Milluni mines are producing considerable tin barrilla, so far the work has been mainly of a development character, and better equipment is necessary before the output can be materially increased.

The ore brought down to the mill is dumped into a bin over a 2-in. grizzly. The oversize goes to the same bin after passing through a Blake-style crusher. The bin feeds two pneumatic stamps, which crush the ore to pass 16- or 18-mesh screens and have a daily capacity of 40

tons each. The stamp pulp is classified to five sizes, each of which feeds a table. These tables make a finished concentrate, a middling which carries whatever pyrite the ore contained, and tailings and slimes. The middlings from the two coarsest tables are ground in a chilean mill and re-treated on two other tables. The middlings of these tables, together with those from the three finer tables of the first group, are calcined if much pyrite is present. The calcined material is screened by hand through a 60-mesh screen, the oversize of which goes to a second chilean mill and the undersize to an eighth table. The tails and slimes of the sixth and seventh tables go to the buddles, those from the first five tables to a spitzkasten, the settlings of which go to a ninth table. If the ore does not require calcining the middlings of tables 3 to 7 are reground in the second chilean mill and retreated on tables 10 and 11. The tails and slimes of tables 6 to 11 are treated in buddles, of which there are 12, with a diameter of 240 cm. The concentrates of the buddles are returned to the second chilean mill, the middlings are re-treated on the buddles and the tailings discarded. The overflow of the buddles is settled in sluices, and the settlings returned to the buddles.

At present the equipment of the mill is such that only one stamp can be used at a time, but it is proposed to put

A GROUP OF AYMARA INDIANS OF NORTHERN BOLIVIA

in three more tables and another chilean mill, whereby it will be possible to take care of the pulp of both stamps and hence double the capacity of the mill.

From Milluni we crossed a snow-covered divide, said to be over 17,000 ft. in elevation, to the group of bismuth-tin mines. On one side of a snow-capped ridge is the Santa Rosa and other mines not now in operation, where formerly considerable tin ore was obtained. There are several different veins in sandstones in which the cassiterite is associated with quartz and pyrite. At the margins of the veins some native bismuth was obtained. Because of the extreme altitude, almost 17,000 ft., and the inaccessibility of these mines they have all been closed, although they contain some promising leads of ore.

On the opposite side of the mountain are the Carmen, Esperanza and Santa Alberti mines. At the time of our visit the principal mining was being done in the Carmen mine, where the bismuth ore is of greater value than the tin. The vein system in the Carmen mine is less definite than in the Milluni mines, much of the ore occurring in stringers in the quartzite where there has been considerable shattering of the rock. The greatest amount is found in the quartzite near the contact with the slate, with a small quantity of ore in small stringers in the slate. Drifts are run in the quartzite near the slate, and the bunches of ore encountered are separated from the barren rock. The fine large specimens of native bismuth exhibited by Bolivia at the Panama-Pacific Exposition at San Francisco came from this mine. It is said that some years ago one mass of practically pure metallic bismuth was found, weighing two tons.

The ore of the Carmen mine consists of native bismuth, bismuthinite, and bismuth oxide associated with considerable pyrite, some cassiterite, and an extremely small amount of quartz. The native bismuth and bismuthinite are apt to have a coating of soft yellowish-white oxide. In some cases the native bismuth is surrounded by a band of bismuthinite but usually one finds specimens of radiating bladed ore with the two minerals alternating, indicating contemporaneous origin.

Almost all the tin-ore streaks contain some bismuth, although the largest masses of bismuth ore are practically free from cassiterite. As in the case of the Milluni mines, the mining is crude, the mines imperfectly equipped and the output small. The best-grade bismuth ore is sorted out by hand and sacked at the mine, while the lower-grade bismuth-tin ore is sent to La Union mill, 6 km. down the valley, in small cars run on a narrow-gage track.

La Union Mill of Huet Hermanos

The best grade of bismuth ore, brought to the mill in sacks, is dumped on a floor, where Indian women break the large pieces and sort them in three grades. The first grade consists of pieces of practically pure native bismuth, bismuthinite or bismuth oxide. The second grade contains the material in which considerable bismuth or bismuthinite shows distinctly, containing 5% or more of bismuth. Since the beginning of the European War all ore containing 5% Bi has been exported to Europe without concentration. The third class is passed through stamps and then roasted to eliminate the sulphur of the pyrite and render the iron magnetic. The iron is then removed in a magnetic separator and the bismuth obtained by lixiviation, leaving the cassiterite to be recovered by the physical methods of concentration.

The ore that contains mainly tin, with small amounts of bismuth, passes over a grizzly, the fines going directly to stamps and the coarse first to a jaw crusher and then to the stamps. The materials from the stamps pass through a 16-mesh screen and thence to Wilfley tables, which produce five products. The first contains about 5% Bi and is shipped at once for export; the second, containing 65% Sn, is also shipped, as *barrilla*. The third and fourth grades, containing pyrite, some cassiterite and bismuthinite, are treated separately, but in the same way by roasting and the resulting iron oxide removed by a magnetic separator, and the bismuth recovered by lixiviation. The tailings are reground in a chilean mill, then passed over Wilfley tables with the seconds treated in a series of buddles. The coarsest material from the first buddle is again ground in a chilean mill and passed over a Wilfley table that produces *barrilla* for export, while the seconds and tailings go to buddles.

By way of summary it may be said that the mining situation in the Huayni-Potosi region at the present time is promising, on account of the tin as well as the bismuth now obtained there, but the mines and mills are greatly in need of improved equipment and more systematic management in order to achieve the best results.

Minerals Separation, Ltd., vs James M. Hyde

On Dec. 11, 1916, Justice Clark delivered the opinion of the United States Supreme Court in the case of Minerals Separation, Ltd., against James M. Hyde. As is well known, Hyde installed a flotation process at the Butte & Superior property, at Butte, Mont., which Minerals Separation claimed was an infringement of their patent rights. The case has been in litigation for several years and has been carried up to the Supreme Court, whose decision has just been delivered. The following is the decision in full as rendered:[1]

"In this suit the complainants, the first named as the owner and the other as general licensee, claim an infringement of United States letters patent No. 835,120, issued on the 6th day of November, 1906, to Henry Livingston Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot. The usual injunction, accounting and damages are prayed for. The District Court sustained the patent as to claims numbered 1, 2, 3, 4, 5, 6, 7, 9, 10, 11 and 12; found that the defendant had infringed each of these claims, and granted the prayer of the petition. The Circuit Court of Appeals for the 9th Circuit reversed the decree of the District Court and remanded the case with instructions to dismiss the bill. The case is here on writ of certiorari to review that decision.

"As stated in the specification, the claimed discovery of the patent in the suit relates 'to improvements in the process for the concentration of ores, the object being to separate metalliferrous matter from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for such metalliferous matter over gangue.'

"The answer denies all of the allegations of the bill and it avers that in 25 designated United States and 5 British patents the process described in suit was 'fully and clearly described and claimed,' and it also avers that the claimed discovery was invented, known and used by many persons long prior to the time when the application was made for the patent in suit. Notwithstanding this elaboration of denial, counsel for the defendant in the summarized conclusion to their brief rely upon only five of the many patents referred to as showing that the patent in suit was anticipated and is therefore invalid for want of novelty and invention, viz.: Everson (1886), Froment (Italy, 1902; Great Britain, 1903), Glogner (1913), Schwarz (applied for April 19, 1905, issued Dec. 19, 1905), and Kirby (applied for Oct. 17, 1903, issued Dec. 18, 1906). And the defendant, a man obviously experienced in the subject, says that, in his opinion, the whole basis of flotation concentration was disclosed in the Everson United States patent No. 348,157 and in the Froment British patent. It is clear that in the prior art, as it is developed in this record, it was well known that oil and oily substances had a selective affinity or attraction for, and would unite mechanically with, the minute particles of metal and metallic compounds found in crushed or powdered ores but would not so unite with the quartz or rocky metallic material, called 'gangue'—Haynes British patent (1860), and the United States patents, Everson (1885), Robson (1897) and Elmore (1901). It was also well known that this selective property of oils and oily substances was increased when applied to some ores by the addition of a small amount of acid to the ore and water used in process of concentration—United States patents, Everson (1885), Elmore (1901), and Cattermole (1904).

"Prior to the date of the patent in suit a number of patents had been granted in this and other countries for processes aiming to make practical use of this property of oil and of oil mixed with acid in the treatment of ores, all of which, speaking broadly, consisted in mixing finely crushed or powdered ore with water and oil, sometimes with acid added, and then in variously treating the mass—'the pulp'—thus formed so as to separate the oil, when it became impregnated or loaded with the metal and metal-bearing particles, from the valueless gangue. From the resulting concentrates the metals were recovered in various ways.

"The processes, of this general character, described in the prior patents may be roughly divided into two classes. The process in the patents of the first class is called in the record the 'surface flotation process' and it depends for its usefulness on the oil used being sufficient to collect and hold in mechanical suspension the small particles of metal and metalliferous compounds and by its buoyancy to carry them to the surface of the mixture of ore, water and oil, thus making it possible, by methods familiar to persons skilled in the art, to float off the concentrate thus obtained into any desired receptacle. The waste material, or gangue, not being affected by the oil and being heavier than water sinks to the bottom of the containing vessel and may be disposed of as desired.

"The process of the other class, called in the record the 'metal sinking process,' reverses the action of the surface flotation process and is illustrated by the Cattermole United States patent No. 777,273, in which oil is used to the extent of 4% to 6% to 10% of the weight of the metalliferous mineral matter, depending on the character of the ore, for the purpose of agglomerating the oil-coated concentrate into granules heavier than water, so that they will sink to the bottom of the containing vessel, permitting the gangue to be carried away by an upward flowing stream of water.

"The process of the patent in suit, as described and practiced, consists in the use of an amount of oil which is 'critical,' and minute as compared with the amount used in prior processes, 'amounting to a fraction of 1% on the ore,' and in so impregnating with air the mass of ore and water used, by agitation—'by beating the air into the mass'—as to cause to rise to the surface of the mass, or pulp, the froth, peculiarly coherent and persistent in character, which is composed of air bubbles with only a trace of oil in them, which carry in mechanical suspension a very high percentage of the metal and metalliferous particles of ore which were contained in the mass of crushed ore subject to treatment. This froth can be removed and the metal recovered by processes with which the patent is not concerned.

"It is obvious that the process of the patent in suit, as we have described it, is not of the metal sinking class, and while it may, in terms, be described as a surface

[1]This version is from an unofficial copy of the decision and is subject to revision, which, however, will probably be in minor details only. Our Washington correspondent reports an unusual feature of the handling of the case was the fact that the proof of the opinion was not made public. Uusually on decision days the galley proof of the decisions may be inspected by those interested. The reason for this is thought to be that substantial changes were made in the opinion after it had been put in type. The official text of the opinion will not be made public until the last of the week.

flotation process, yet it differs so essentially from all prior processes in its character, in its simplicity of operation and in the resulting concentrates, that we are persuaded that it constitutes a new and patentable discovery.

"The prior processes which we have described required the use of so much oil that they were too expensive to be used on lean ores, to which they were intended to have their chief application, and the efforts of investigators for several years prior to the discovery of the process in suit had been directed to the search for a means or method of reducing the amount of oil used, and it is clear from the record that approach was being made, slowly, but more and more nearly to the result which was reached by the patentees of the process in suit in March, 1905. The Froment Great Britain patent (1903) and the Kirby United States patent (applied for in 1903 and granted in 1906) are especially suggestive of the advance which was being made toward the desired result, but the Froment process was little more than a laboratory experiment and has never proved of value in practice, and the Kirby process though approaching in some respects more nearly to the end attained by the process of the patent in suit, found its preferred application in the use of an amount of oil in solution equal to one-fourth to three-fourths in weight of the ore treated, which was prohibitive in cost.

"Into this field of investigation at this stage of its development came the patentees of the patent in suit. They were experienced metallurgists of London, of inventive genius and with financial resources, and they entered upon an investigation of the processes of oil concentration on ores which was continued through several years and consisted of a very extended series of experiments in which the quantities of oil, of water and of acid used and the extent and character of the agitation of the mass under treatment resorted to, were varied to an almost unparalleled extent as to each factor and the results were carefully tabulated and interpreted. It was while pursuing a comprehensive investigation of this character, having, as the evidence shows, the special purpose in mind at the time to trace the effect on the results of the process of a reduction to the vanishing point of the quantity of oil used, that the discovery embodied in the patent in suit was made. The experimenters were working on the Cattermole 'metal sinking process' as a basis when it was discovered that the granulation on which the process depended practically ceased when the oleic acid (oil) was reduced to about 0.5% 'on the ore.' It was discovered, however, that, as the amount of oleic acid was further reduced and the granulation diminished, there was an increase in the amount of 'float froth,' which collected on the surface of the mass and that the production of this froth reached its maximum when about 0.1% or slightly less 'on the ore' of oleic acid was used. This froth on collection, was found to consist of air bubbles modified by the presence of the minute amount of oil used and holding in mechanical suspension between 70% and 80% of the total mineral content of the mass treated. It was promptly recognized by the patentees that this froth was not due to the liberation of gas in the mass treated by the action of the dilute acid used, and its formation was at once attributed in large part to the presence of the air introduced into the mixture by the agitation which had been resorted to to mix the oil with the particles of crushed ore, which air, in bubbles, attached itself to the mineral particles, slightly coated as they were with what was necessarily an infinitesimal amount of oil, and floated them to the surface. The extent of the agitation of the mass had been increased as the experiments proceeded until the 'series of Gadbett mixers, fitted with the usual baffles, were speeded at from 1,000 to 1,000 r.p.m.'

"Consideration of the record in this case convinces us that the facts with respect to the process of the patent in suit are not overstated by the plaintiff's witness, Adolph Liebmann, an expert of learning and experience, when he says in substance:

" 'The present invention differs essentially from all previous results. It is true that the oil is one of the substances used but it is used in quantities much smaller than was ever heard of, and it produces a result never obtained before. The minerals are obtained in the froth of a peculiar character, consisting of air bubbles which in their covering film have the minerals embedded in such a manner that they form a complete surface all over the bubbles. A remarkable fact with regard to this froth is that, although the very light and easily destructible air bubbles are covered with a heavy mineral, yet the froth is stable and utterly different from any froth known before, being so permanent in character that I have personally seen it stand for 24 hr. without any change having taken place. The simplicity of the operation, as compared with the prior attempts, is startling. All that has been done is to add a minute quantity of oil to the pulp to which acid may or may not be added, agitate for from 2½ to 10 min. and then after a few seconds collect from the surface the froth which will contain a large percentage of the minerals present in the ore.'

"It is not necessary for us to go into a detailed examination of the process in suit to distinguish it from the processes of the patents relied on as anticipations, convinced as we are that the small amount of oil used makes it impossible that the lifting force which separates the metallic particles of the pulp from the other substances of it is not to be found principally in the buoyancy of the oil used, as was the case in prior processes, but that this force is to be found, chiefly, in the buoyancy of the air bubbles introduced into the mixture by an agitation greater than and different from that which has been resorted to before and that this advance on the prior art and the resulting froth concentrate so different from the product of other processes make of it a patentable discovery as new and original as it has proved useful and economical. It results without more discussion that we fully agree with the decision of the House of Lords, arrived at upon a different record and with different witnesses, but when dealing with the equivalent of the patent in suit, in Minerals Separations, Ltd., vs British Air Concentration Syndicate, Ltd., 27 R. P. C. 33. In this decision, Lord Shaw, speaking for the court and distinguishing the process there in suit especially from the Elmore oil-flotation process which had gone before but which was typical of the then prior art, said: 'They (the patentees of the agitation-froth process of the patent in suit) are not promoting a method of separation which had before been described, but they are engaged upon a new method of separation. Instead of relying upon the lesser specific gravity of oil in bulk they rely upon production of a froth by means of an agitation

which not only assists the process of the minute quantities of oil reaching the minute particles of metal, but forms a multitude of air cells, the buoyancy of which air cells, forming around single particles of the metal, floats them to the surface of the liquid,' and Lord Atkinson said: 'In their process this mysterious affinity of oil for the metallic particles of the ore is availed of, yet the oil is used in such relatively infinitesimal quantities, that the metallic particles are only coated with a thin film of it, and the lifting force is found not in the natural buoyancy of the mass of added oil, but in the buoyancy of air bubbles, which, introduced into the mixture by a more or less violent agitation of it, envelop or become attached to, the thinly oiled metallic particles, and raise them to the surface, where they are maintained by what is styled the surface tension of the water.'

"The record shows not only that the process in suit was promptly considered by the patentees as an original and important discovery, but that it was immediately generally accepted as so great an advance over any process known before that, without puffing or other business exploitation it promptly came into extensive use for the concentration of ores in most, if not all, of the principal mining countries of the world, notably in the United States, Australia, Sweden, Chile and Cuba and that, because of its economy and simplicity, it has largely replaced all earlier processes. This, of itself is persuasive evidence of that invention which it is the purpose of the patent laws to reward and protect. Diamond Rubber Co. vs. Consolidated Tire Co. 220 U. S. 428; Carnegie Steel Co. vs. Cambria Iron Co. 185 U. S. 403, 429, 430; the Barbed Wire Patent, 143 U. S. 275; Smith vs. Goodyear Dental Vulcanite Co. 93 U. S. 486.

"The claim that the patentees of the patent in suit are not the original discoverers of the process patented because an employee of theirs happened to make the analyses and observations which resulted immediately in the discovery, cannot be allowed. The record shows very clearly that the patentees planned the experiments in process when the discovery was made; that they directed the investigations day by day, conducting them in large part personally and that they interpreted the results. Agawam Co. vs. Jordan 7 Wall. 583, 603, rules this claim against the defendant.

"Equally untenable is the claim that the patent is invalid for the reason that the evidence shows that when different ores are treated, preliminary tests must be made to determine the amount of oil and the extent of agitation necessary in order to obtain the best results. Such variation of treatment must be within the scope of the claims, and the certainty which the law requires in patents is not greater than is reasonable, having regard to their subject matter The composition of ores varies infinitely, each one presenting its special problem and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case. The process is one for dealing with a large class of substances and the range of treatment within the terms of the claims, while leaving something to the skill of persons applying the invention, is clearly sufficiently definite to guide those skilled in the art to its successful application, as the evidence abundantly shows. This satisfies the law. Mowry vs. Whitney 14 Wall 620; Ives vs. Hamilton 92 U. S. 426; and Carnegie Steel Co. vs. Cambria Iron Co. 185 U. S. 403, 436, 437.

"The evidence of infringement is clear.

"While we thus find in favor of the validity of the patent, we cannot agree with the District Court in regarding it valid as to all of the claims in suit. As we have pointed out in this opinion there were many investigators at work in this field to which the process in suit relates when the patentees came into it, and it was while engaged in study of prior kindred processes that their discovery was made. While the evidence in the case makes it clear that they discovered the final step which converted experiment into solution, 'turned failure into success' (the Barbed Wire Patent, 143 U. S. 275); yet the investigations preceding were so informing that this final step was not a long one and the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions' 'amounting to a fraction of 1% on the ore,' and therefore the decree of this court will be that the patent is valid as to claims numbered 1, 2, 3, 5, 6, 7, and 12 and that the defendant infringed these claims but that it is invalid as to claims 9, 10 and 11. Claims numbered 4, 8 and 13 were not considered in the decrees of the two lower courts and are not in issue in this proceeding.

"The decision of the Circuit Court of Appeals will be reversed and the decision of the District Court modified to conform to the conclusions expressed in this opinion, will be affirmed."

Experimental Kelp Plant at Summerland, Calif.

The Bureau of Soils of the Department of Agriculture is preparing to erect at Summerland, Calif., an experimental plant for the production of potash from Pacific Coast kelp. The details of the plant are not completely developed yet, but D. F. Houston, Secretary of Agriculture, states that the plans contemplate the drying of the kelp as it comes from the water in a series of rotary driers, after which the dried material will be distilled in retorts analogous to a byproduct-coke oven.

Ammonia, combustible gas, tar and some other materials will be recovered, and the resulting charcoal will contain the potash salts. These will be leached out and recovered by evaporation, after which the charcoal will be available either as a marketable commodity or as fuel. By recovering the various byproducts and saving the heat units involved in the combustion of the kelp, the Bureau of Soils hopes to develop a process that will permit the continued production of potash from this American source.

Minerals Separation North American Corporation

The Minerals Separation North American Corporation, incorporated under the Laws of Maryland, has taken over and assumed all the assets, interests and obligations of Minerals Separation American Syndicate (1913) Limited, as of Dec. 7, 1916. The capital of the corporation is divided into 500,000 shares of no nominal or face value. The directors are John Ballot, president; Dr. S. Gregory, vice president, and Frank Altschul. No dislocation or disturbance whatever will take place in the business as hitherto carried on by the old company.

Editorials

Minerals Separation, Ltd., Wins

The Supreme Court of the United States on Dec. 11 announced its decision in the suit of Minerals Separation, Ltd., vs. Hyde, involving the basic patent for the flotation process of concentrating ores. The opinion was written by the new justice, John H. Clarke, and was unanimous. The invention was held to be new and patentable insofar as the practice at the Butte & Superior mill is concerned and the operations of the defendant Hyde at the Butte & Superior mill in Montana were held to be an infringement.

The opinion reviews the history of the process and gives full credit to the Minerals Separation patentees for having made a real discovery. The prior patents that were relied upon by the defendant were carefully considered and held not to anticipate the invention. A decision of the British House of Lords is referred to as having recognized the novelty of the invention.

This decision is an event of major importance. The process has come into extensive use in the United States, about 25,000,000 tons of ore having been treated by it during 1916. About half of this was treated under license of the patentees, the remainder in defiance of the patents. Anaconda, Inspiration, Senator Clark's companies and numerous others secured licenses and paid royalties. The Hayden, Stone & Jackling group of companies, including Butte & Superior, Utah and several others, have proceeded in defiance of the patents and are now confronting the situation that the profits made by an infringer from the use of an invention belong to the patentee. The Hayden, Stone & Jackling copper companies have not been large users of this process until recently, when they became alive to the desirability of correcting their metallurgical backwardness, which has been exhibited by their low extractions. Butte & Superior, on the other hand, has used the flotation process long and largely and admittedly owes much of its success to it. At a recent argument in Butte, before George M. Bourquin, U. S. district judge, it was contended by Minerals Separation, Ltd., that the profits of Butte & Superior, as shown by its own reports, attributable to the invention have been nearly $16,000,000. Butte & Superior will doubtless make a different contention. Settlement of this question will be, of course, a matter for adjudication.

The Miami Copper Co. also defied the patents, and there is already a judgment against it in the United States District Court at Wilmington, Del., and it has given a bond of $250,000 to stay the injunction pending appeal. It is a matter of much interest that the Supreme Court of the United States has closely followed the opinion of Judge Bradford, of Wilmington, Del., in the Miami case, so that a good part of his decision has been affirmed by the Supreme Court of the United States before it has reached the United States Circuit Court of Appeals at Philadelphia for review, but there were several important features in the Miami case that did not enter into the Hyde case and may still be contested if the Miami company desires to continue the fight. Anyway, Minerals Separation will probably desire to have a final decision respecting these.

The litigation that has now been finally decided has lasted more than five years. The first decision was by Judge Bourquin, of Butte, Mont., in July, 1913, holding the patent valid and infringed. The United States Circuit Court of Appeals at San Francisco, Calif., reversed this decision in May, 1914, and held the patent to be wholly void. This decision led many of the mines to believe that the process was free to all. In October, 1914, an application was made by Minerals Separation to the United States Supreme Court for a writ of certiorari, and to the surprise of everyone the writ was granted. The argument in the Supreme Court included demonstrations in the courtroom at an extraordinary and informal session in the forenoon of the several processes considered. Miniature machines operated by electricity were used, and the courtroom resembled a metallurgical laboratory. The decision was rendered very promptly, the argument having been completed only on Nov. 1.

Thus is ended the most important and most spectacular metallurgical litigation there has ever been in the United States. The opinions respecting the validity of the process—both pro and con—have been sincere, and the trials have been exhaustive and fair. The plaintiffs are Britishers. They will testify as to the fairness and absence of prejudice in American courts. We have deferred any comment upon the technical points of the supreme decision, awaiting the full text thereof. Practically, the next step will probably be an effort by the patentees to collect what is due them. This is a time for the victors to prove that they are generous and for the vanquished to show that they are good losers.

Peace Prospects

The boom in copper stocks culminated on Nov. 18. Ever since then there has been liquidation, with lately some very weak days. On Dec. 12 the market declined, violently on news that Germany had made peace proposals. The copper stocks suffered more than most others. Some of them sank to about where they were before the autumn advance began. Chile, which was around 39 at the middle of November, was down to 23 before the middle of December.

Now the position of none of these companies had changed, except for the better. All had the benefit of one month's additional earnings and all had their expected total production up to the middle of 1917 sold at an extraordinarily high price. All had big surpluses and were assured of bigger ones. The only thing that changed on Dec. 12 was the prospect of the duration of the war and the approach of the uncertainties bound to arise upon its termination. Yet even that was only a question of degree, for no conservative person has been expecting war profits to continue forever. It has been merely a matter of figuring whether they would run for

another six months, or 12 months, or perhaps 18 months. But even as to the longer periods estimated for the war's duration, there has been the serious prospect that natural causes would reduce prices and diminish profits to normal, wherefore the days of enormous earnings were numbered anyhow.

For a year back the stock market has shivered at any intimation of peace, yet why it should do so is beyond comprehension except for the regard of unwise speculative commitments. The advent of peace—the cessation of further increase of misery and the destruction of people and of wealth—should be a great bull argument. Looking at it narrowly—from the selfish interest of this country—good opinion long ago ceased to be so sure that our prosperity would end with the war. On the contrary, it has been becoming more and more evident that prolongation of the war is producing domestic conditions that will be detrimental to our welfare.

What is the meaning of Germany's proposal, what it will come to, we know not. We know only that it comes as a surprise and is significant in that one of the great belligerent parties is willing even to talk of peace. But it is certain that nothing would be so great a blessing for humanity as an early peace on terms that would settle permanently and satisfactorily the questions about which races are in conflict.

What's In a Name?

A rose might smell as sweet by any other name, but a new mining development in the eyes of its promoters must bear the magic of a famous name, plus the inconsequential but necessary "Consolidated" or "Extension." These are necessary, especially if there is no ore developed in the property. The imagination of the public puts the ore in the "Extension" and the flotation usually has a "psychological prosperity" for a time, though as a matter of fact it is remarkable how few of these famous "Extensions" make good. One can count them on one's fingers: United Verde Extension, and Tonopah Extension, and—well, a few others, though we do not recall any "Consolidateds" that have been successful except some real consolidations. In most mining districts it has been the other mines that have made good, and not the "Consolidated" and the "Extension" that traded on the name of the famous mine of the camp.

The geography of some of these flotations is often exceedingly vague. The "Extension" or "Consolidated" may be several miles away from the real mine of that name. A recent flotation stated that its mine was "in the heart of the district" and then proceeded to mention the Ray Consolidated, United Verde and Miami copper mines. We do not know to the heart of what district the promoter referred—probably the "district" of Arizona.

It is also worthy of note that mining companies with fool titles, such as the Intermountain & Intercolonial Mining, Milling, Smelting and Reduction Co., are usually failures; the air necessary to repeat such titles seems to exhaust all the energies of the promoters and prevent these companies from getting into the dividend list. Like the "Extension" and the "Consolidated," they are usually wrecked by poor management or too slender financing. United Verde Extension, now one of the conspicuous exceptions, was a failure until it came under the control of a group of capable mining men in the Southwest who made a careful study of the property and then had sufficient capital to put into effect the prospecting campaign outlined by the technical members of this syndicate.

What constitutes a good name for a mining company? The securing of an adequate name for a new mining development is something of a problem and not often successful. Many Eastern stockholders in mining companies have little idea of where their property is situated. When asked where the property is, they will usually reply that it is "out West," or if pinned down to more definite situation, the stockholder has "an impression that it is either in Nevada or Arizona." As everybody knows, there are a number of waste spots in both of those states, as well as several good districts.

A name such as "Old Baldy" may be satisfactory for a mining company so long as it is only of local interest, or if it has sufficient distinguishing characteristics to impress its remarkable qualities and situation upon its shareholders. Thus what constitutes a good name depends to a considerable extent on whether a company is to be purely local or is intended to appeal to the public generally. If the dominant capital interest is secured in one section and the mine is in another part of the country, it is fitting and enlighting to recognize these two features, as was done in the Pittsburgh-Silver Peak, Calumet & Arizona; the same might be said of some of the newer developments, such as the Calumet & Jerome, or the Pittsburgh-Jerome. But the United Verde Consolidated Copper Co.'s name is obviously a mere play on the success of the United Verde Copper Co.; it is not connected in any way with the present United Verde mine and is in no sense a consolidation of that property, though among the Eastern laymen this misconception may readily be assumed.

When such properties are quoted on the stock exchanges, the inevitable shortening of names for convenient trading identification makes the matter still more confusing to the uninformed mining investor, who for the good of the industry should be protected. An example of the confusion that may arise from similar names is the case of the United Verde Extension, which for months was referred to in the Curb list as United Verde, whereas the latter stock is practically never offered or traded in. There is a great public interest at present in mining stocks, especially in copper stocks. Perhaps it is the most wide-spread public interest that there has ever been in this country in mining stocks. Is the public going to be "stung"? Will the mining societies take any steps to prevent the market for legitimate prospects being destroyed?

Great Britain Acts Respecting Copper

By order of the British government the importation of copper and dealings in copper without a special permit were forbidden on Dec. 8, except for the fulfillment of current contracts. The order also prohibits the use of copper except in case of pending contracts, and directs that all stocks of raw copper be reported not later than Dec. 16.

This drastic order indicates a firmer control of copper than ever by the British government. We have not been informed of its purport. We may imagine, however, that it means that the government will forbid the use of copper for any purpose that is not essential to the welfare of the empire.

For the present it will probably have no effect upon our copper market. Later it probably will, especially if it results in restriction of British consumption. There will be no restriction in the consumption for military purposes, but the man who is figuring on copper roofing will be told to use slate or something else, and so on.

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Protest the Postal Proposals

A strong effort is being made to enact in this Congress legislation increasing postal rates on second-class mail matter. It is proposed to introduce a zone system, and to make a large increase on matter going beyond a limited circle. This will be a direct blow to subscribers to periodicals, who will have to pay for their magazines a great deal more than at present, for the publishers can not stand it and will have to pass it on. Readers should communicate promptly with their representatives in Congress and protest vigorously against this proposal which will touch the pocketbook of every one who subscribes to magazines.

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A Four-Hour Day

The distinguished electrical engineer of the General Electric Co.—Charles P. Steinmetz—prophesies that the time is coming when men will have to work but four hours per day in order to get their living. This is to come from further development of the arts and sciences. The prospect is not quite pleasing. After golf, moving pictures and fishing have palled, what is anybody going to do with the rest of his time? Shall we perhaps some day hear the cry: "Give us work, not that we may eat and clothe ourselves, but that we may create and exercise the innate human desire to do something useful with brain and hands"?

BY THE WAY

There is growing up around the Guggenheims a legend that is about as inaccurate as such things usually are. Some Ferrero of the future probably will have to dig up the facts. One G. C. Forbes, writing recently in *Leslie's Weekly,* recorded that "No mountaineer, no prospector knew more hardships than the Guggenheim brothers went through. The Creator, they soon discovered, had invariably deposited mineral wealth far from settled centers of civilization and had surrounded it with obstacles which only the pioneer and brave elected to encounter. Daniel Guggenheim, with the other brothers, slept in tents or wagons amid wild surroundings as often as under a roof." And then some more slush. Daniel Guggenheim was a bold and far-seeing financier and exploiter, but he was not a pioneer of the type of Mackay and Hearst, and any such intimations are probably quite nauseating to him.

In the early 80's, Meyer Guggenheim, a lace manufacturer of Philadelphia, at the instigation of a fellow Philadelphian, Graham by name, acquired a half-interest in the A. Y. and Minnie mine in California Gulch at Leadville, Colo. The venture proved highly profitable, the A. Y. and Minnie becoming one of the big mines of the district. Benjamin Guggenheim, one of the sons of Meyer, was sent out to the mine as accountant, and he, acquiring more or less information concerning the smelting business, induced his father and brothers to go into it largely because of the unfavorable terms the smelters were making on the A. Y. and Minnie ore, which gradually became more zinky and consequently less desirable in character, from the lead smelters' standpoint. The Guggenheims in company with E. C. Holden (who soon retired) built the Philadelphia works, a large plant at Pueblo, Colo., in 1889. At first this venture was decidedly unsuccessful, but gradually coming to the appreciation of the necessity for securing the best possible technical advice and acting upon that principle, together with their own sharp commercial acumen, they converted into a success what promised to be a failure. Thus having acquired an insight into the smelting business, they early appreciated the great possibilities of smelting in Mexico when the lead-bearing ores of that country were practically excluded from the United States by the tariff of 1890, and erected works at Monterey and Aguascalientes. This expansion in business, to which the tariff of 1890 opened the way, was the real start of the business. When the Philadelphia plant was built, William and one or two other brothers went out to join Benjamin. In later years, when the business had become big, there was a little rift between the brothers who had been in the field and those who had stayed at home. And finally, Benjamin (who was lost with the "Titanic") and William retired from the smelting business.

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"We do not believe," says the market letter of a Stock Exchange house, "that the position can ever be essentially sound until the curb market has been put through a period of liquidation such as it has never known, and which it never needed more than today because of reckless dealings in many nondescript issues made only to sell." Whether one agrees with this or not, remarks the *Evening Post,* it calls attention to a probable condition. In an era of speculation such as this, there is drawn into the market not only the rich but the poor. Newspapers print stories of wealth over night, and men with anywhere from $25 to $100 to "invest" rush down to the curb market—the only place where they can speculate with so little—and buy some cheap mining stock, quoted, perhaps, as low as 25c. a share. Now it is true that some of these shares can go up, and some of them do; and when that happens office-boys and runners bloom into curb brokers, and a curb broker or two blooms into a millionaire, and the changes of fortune rival those of the Arabian Nights. But the chances are 100 to 1 that any given cheap stock is already overbought; for with this tremendous influx of penny-speculators (overwhelmingly bulls) into the market, who cannot afford to buy the higher-priced stocks, there is nothing to suppose but that they buy the cheap mining stocks; that the cheaper they are the more they are apt to be bought; that they are bought not on their merits, but simply as the only passage of fulfilment for the blind desire to "get aboard" the market and enjoy the rises. Consequently the probabilities are always that a curb stock nowadays selling at from 25c. to $5 (or perhaps a bit higher) isn't worth even that much. The price they are selling at, low as it is, is fictitious. The chances are always that the cheap stocks are far more overbought than the higher-priced ones; and for no other reason than that they are cheap.

New Publications

Cours d'Hydraulique. By J. Grialou. 6½x10, pp. 543, illus.; paper. Gauthier-Villars et Cie., Paris.

Standards for Electric Service. Pp. 262. Circular of the U. S. Bureau of Standards, No. 56, Washington, D. C.

Commission of Conservation, Canada, Seventh Annual Report. Pp. 283, illus. Commission of Conservation, Montreal, Canada.

Trust Laws and Unfair Competition. By Joseph E. Davies. Pp. 832. Department of Commerce, Bureau of Corporations, Washington.

Geology of the Nanaimo Map-Area. By Charles H. Clapp. Pp. 135, illus. Memoir 51, Canada Department of Mines, Geological Survey Branch, Ottawa.

Abstracts of Current Decisions on Mines and Mining, January to April, 1916. By J. W. Thompson, pp. 90. Bull. 126, U. S. Bureau of Mines, Washington.

Organic Chemistry for the Laboratory. By W. A. Noyes. Third edition, revised and enlarged. 5½x8¾, pp. 291, illus. The Chemical Publishing Co., Easton, Penn.

The Pleistocene and Recent Deposits of the Island of Montreal. J. Standfield. Pp. 80, illus. Memoir 73, Canada Department of Mines, Geological Survey Branch, Ottawa.

Economic Geology. By Heinrich Ries. 5½x9, pp. 856, illus. John Wiley & Sons, New York. An extensive review of this work will be published at an early date.

Iowa Geological Survey, Volume XXV. Annual Report, 1914, with accompanying papers. George F. Kay, State Geologist. 7½x10, pp. 627, illus. Iowa Geological Survey, Des Moines.

The Fundamental Principles of Petrology. By Dr. Ernst Weinschenk. Authorized translation from German by Albert Johannsen. 6x9, pp. 214, illus.; $2.50. McGraw-Hill Book Co., New York.

An Introduction to Mine Surveying for Surveyors and Students of Coal Mining. By Thomas Bryson and George M. Chambers. 4½x7¼, pp. 288, illus.; $1.40. Longmans, Green & Co., New York.

Silver and Gold. A Pictorial Souvenir of the Mines of Northern Ontario. 12x9, pp. 64, illus., paper, $1.60. The Cobalt Daily Nugget, Ltd., Cobalt, Ont., Canada.

Booklet contains one page of production data and 62 pages of halftone illustrations of various mining properties in the Cobalt district.

The Geological and Mineral Resources of the Yilgarn Goldfield. Part II, The Gold Belt South of Southern Cross. By T. Blatchford, with petrological notes by R. A. Farquharson and mineralogical contributions by E. S. Simpson and A. J. Robertson. Pp. 189, illus. Bull. 63, Western Australia Geological Survey, Perth.

Water Powers of Canada. A Reprint of a Series of Five Monographs Covering the Water-Power Situation in Canada, Prepared for Distribution in Connection with the Exhibit of the Dominion Water Power Branch in the Canadian Pavilion at the Panama-Pacific International Exposition, San Francisco, 1915. Pp. 361, illus. Department of Interior, Dominion Water Power Branch, Ottawa.

Transactions of the American Institute of Chemical Engineers, Volume VIII, 1915. 6x9, pp. 309, illus. D. Van Nostrand, New York.

Some of the articles contained in this volume which are of especial interest to the mining industry are: Resources and Possibilities of Chemical Industry in the Southwest; the Chemical Evidence of Smelter Smoke Injury to Vegetation; Cottrell Processes of Electrical Precipitation; the Fleming Patent Dust-Collecting System; the Thiogen Process for Removing Sulphur Fumes; the Production of Ammonia from Cyanamid.

An Introduction to Mining Science; A Theoretical and Practical Textbook for Mining Students. By John B. Coppock and G. A. Lodge. 4½x7, pp. 230, illus.; 60c. Longmans, Green & Co., London, England.

This is a practical little book with a misnomer. It is solely a book descriptive of that part of mining science having to do with combustible and incombustible gases underground and is therefore most applicable to coal mining. For the coal miner the book is a most valuable one. Each chapter is followed by a set of "quiz" questions, which is an excellent idea in a book of this kind.

Handbook of Rock Excavation Methods and Costs. By Halbert Powers Gillette. 4¾x7¾, pp. 835, illus.; leather; $5. Clark Book Co., New York, N. Y.

Like other cost handbooks by the same author, this volume is composed for the major part of material published in "Engineering and Contracting." For mining engineers it finds its chief use as the basis for preliminary estimates rather than as a comparison of existing costs. For the construction engineer it is useful as a means of assisting in the choice of methods to be employed, as it presents a variety of conditions and the expected costs under these conditions.

Coal and Coke. By Frederick H. Wagner. 6x9, pp. 431, illus.; $4. McGraw-Hill Book Co., New York.

The book was written, as the author states, to present to the American student of coal-gas production data in a concise form covering the various systems of coal carbonization. In Part 1, comprising about one-quarter of the book, the origin and classification of coal is discussed, together with the physical characteristics, oxidation and spontaneous combustion, the coking qualities of various coals, and the testing and analyzing methods. The rest of the book is devoted to the manufacture of coke, in retort benches and various types of ovens. The volume has many illustrations, diagrams and tables and well fulfills the aim of the author.

Hendricks' Commercial Register of the United States for Buyers and Sellers. 7¾x10½, pp. 1887, "Fabrikoid" binding; $10. S. E. Hendricks Co., New York.

The 21st annual edition of this well-known directory has just been issued, and in the main it follows out the plan of the preceding issues. However, it contains an important addition in the form of a list of trade names, brands, titles of identification, etc., which furnishes ready reference for purchasing agents and prospective buyers to distinctive products manufactured by firms listed in the work. This new feature accounts for the increase in pages from about 1,500 last year to over 1,800 this year, of which the index takes up about 150. The book is well indexed, well arranged as regards classification of the various industries, and, we believe, is as complete as it is possible to make such a directory.

The Mines Handbook. An Enlargement of the Copper Handbook. A Manual of the Mining Industry of North America. By Walter Harvey Weed. 5½x8¼, pp. 1,699; $10. Vol. XII, supplementing Volumes I to XI. The Stevens Copper Handbook Co., New York.

This work is a renewal of the "Copper Handbook," which was published for a number of years by the late Horace J. Stevens, and was taken over by Walter Harvey Weed. The last edition was published in 1914, and had consequently become somewhat out of date. The present volume has been enlarged to include mines of gold, silver, lead, zinc and other nonferrous metals, in addition to copper, and its value is thereby correspondingly increased. We observed a great deal of new and useful matter, such as chapters devoted to glossary of mining terms; mineralogy; complete list of copper minerals; the metal-mining industry, giving data on occurrence and uses of the different metals, with production, prices, etc., lists of obsolete mining securities, mining company officials; and geographical index. Descriptions of the foreign properties have been omitted, the present work covering the United States, Canada and Mexico. Detailed information regarding the companies in these countries takes up 1162 pages. The work seems to have been done better than ever before.

The Engineer in War. With Special Reference to the Training of the Engineer to Meet the Military Obligations of Citizenship. By P. S. Bond. 5x7¼, pp. 187, illus., leather; $1.50. McGraw-Hill Book Co., New York.

One year ago the United Engineering Societies of New York City inaugurated a course of lectures by various officers of the Corps of Engineers, U. S. A., dealing with the work of engineer officers and troops in time of war. The object was to acquaint the engineers of the various societies with some of the details and specific work required, which it was presumed they would be ready and volunteer to do in case of war. A similar system of military-engineering lectures was immediately started in Chicago, the societies there being fortunate in securing Major Bond as lecturer. The present volume is the outcome of this series of lectures and in a way a résumé of all the ground covered. It gives in a most readable and interesting form a perspective of the scope of military engineering and does not attempt to cover the technical details. It is a valuable book and should be read by every engineer, and will be found especially valuable to those who purpose joining the Engineer Reserve Corps, recently provided for by Congress. At the end of the book is an extensive bibliography for further reading and study along military lines. This list was issued by the War Department and was published in the "Engineering and Mining Journal," Feb. 5, 1912.

Elements of Mining. By George J. Young. 6x9, pp. 628, illus.; $5. McGraw-Hill Book Co., New York.

As a textbook for students, it fills a need for an uptodate exposition of modern mining methods. In the section devoted to rock breaking, a table giving the physical properties of rocks tabulates the explosive force in foot-pounds per square foot of fracture necessary to effect disruption. Tables and formulas follow enabling the calculation of the amount of explosives consumed in blasting under given conditions. Copious illustrations show the approved methods of drilling and placing holes to attain maximum blasting efficiency with a minimum consumption of explosives. Cost data receive proper attention and comparative cost diagrams, showing tons broken per dollar spent under various conditions of mining, add the final touch. The section devoted to the support of mine workings is especially commendable, inasmuch as it clearly applies the principles of the strength of construction materials to the support of given rock masses. For the engineer perhaps one of the most valuable sections is that giving a compilation of uptodate mining methods underground. Most textbooks written before caving systems, and others contemplating the reduction of timbering to a minimum, had been so extensively adopted as in recent years, are hopelessly out of date. The present work gives a compilation of methods applied in the latest approved mining practice, which is admirably illustrated with copious drawings and diagrams. Sections are devoted to drilling, development, drainage, ventilation, openpit mining, organization, accounting and examination of mineral deposits.

Concentrating Ores by Flotation. A Description and History of a Recent Metallurgical Development, Together with a Summary of Patents and Litigation. By Theodore J. Hoover. Third Edition. 6x9, pp. 320, illus. The Mining Magazine, London, England.

The third edition of Hoover's classic on flotation appears bearing the date of June 14, 1916. The book, as before, supplies the reader with a comprehensive description of the flotation process its basic theory and the reasons for its application in practice. This edition contains a chapter, bearing on American practice, that did not appear in the former publication. The value of the book to readers in general has thereby been considerably increased. Mr. Hoover's close connection with the flotation process since its inception and his practical labors in it, including, as they do, the invention of some of its most successful machines, make this work of great value to the metallurgical world, while the author's fairness in discussion entitles him to the serious consideration of everyone interested in flotation. It is a pity, perhaps, that the part of the book that has been reprinted from former editions has not been more carefully revised in order to eliminate possible errors and to reconcile statements made during the darker days of the process with those now widely accepted. Nothing, however, can detract from the high value at which the book must be held, and the thanks of the metallurgical fraternity may not be withheld from the author, who, above all others, has made this newest of metallurgical processes well known to the professional world. Mr. Hoover is to be congratulated upon his work. The book is good and authoritative, and will always be highly valued.

The Flotation Process. By Herbert A. Megraw. 6x9, pp. 240, illus.; $2.50. McGraw-Hill Book Co., New York.

Any book dealing with a subject which is both deepening and expanding with the rapidity of the flotation process must labor under difficulties. If the present work fails to satisfy our curiosity as to the theoretical principles of the art, it affords as complete a record of present operating details as could be desired. Much of the material has appeared in print before, in the "Engineering and Mining Journal" and elsewhere, but the author of the book has exercised good judgment in its compilation and was himself the writer of some of the republished matter. The theoretical explanations are based on the opinions of Hoover, Ingalls, Rickard, Coghill, Free, Bancroft and Van Arsdale, with comments by the author. The chapter on "Oils and Their Uses" is one of the most valuable in the book. The author's comment that probably almost any oil can be made to yield a satisfactory frothing concentration on almost any ore, provided all the other operating factors are correctly adjusted, deserves careful consideration. The value of gas tar as a universal collecting agent is duly emphasized, and the peculiarities of a great variety of common and less common oils are noted. The chapter on "Testing" is enriched by actual data from a number of published tests. (The one by H. J. French is erroneously credited to the Colorado instead of to the Columbia School of Mines Quarterly.) Tests by the United States Bureau of Mines on Oxidized ores shed light on a most difficult problem, and the chapter devoted to the elaborate testing conducted at the Washoe plant offers a vast fund of suggestive information. In discussing the "Application of Flotation," the author takes the reasonable, but sometimes disputed, ground that for treating an ore from which, by any reasonable care, some coarse concentrate can be recovered by older methods, flotation should be considered as a last resort, for reducing tailings losses in slime. The final chapters record the latest practical applications of flotation as installed at some of the most important mines of the world. Broken Hill, Yerranderie, Newhouse, Park City, Cœur d'Alene district, Idaho Springs, Anaconda, Braden and Arizona. We commend this book especially to those who desire to know how flotation is actually working at present.

Personals

J. J. Hasbrouck has left Coquimbo, Chile, and is on his way to New York.

Horace N. Trumbull has been made advertising manager for the S K F Ball Bearing Co., Hartford, Conn.

Frank M. Leland has resigned as manager and consulting engineer for the Empire Copper Co., Mackay, Ida.

Nelson Dickerman has returned to San Francisco from Bolivia, where he has been doing examination work.

Fred. L. Vahrenkamp has become managing director and consulting engineer, for the Empire Copper Co., Mackay, Ida.

Harold K. Hochschild, a director of the American Metal Co., sails on Saturday of this week for a visit to South America.

D. M. Liddell, consulting engineer for Merrill, Lynch & Co., has been visiting various steel plants in Pittsburgh, Buffalo and the Middle West.

H. D. Richardson has resigned the superintendency of the Boise-Rochester mine at Atlanta, Idaho, and is now at the Hotel Clark, Los Angeles.

J. B. Tyrrell, of Toronto, has gone to the East Kootenay district in British Columbia to examine and sample one of the silver-lead mines in that section.

F. H. Sistermans, of El Paso, formerly of the firm of Sistermans, Munro & Savage, recently dissolved, has gone to Sonora to investigate a mining property.

F. J. Brulé has resigned as superintendent of construction for the Anaconda Copper Mining Co. to become chief engineer for the British America Nickel Corporation.

H. J. Wallace, formerly field engineer for the Anaconda Copper Mining Co. at the B. & M. reduction department, has been appointed superintendent of construction.

Harry B. Byrne, manager of the Butte office of Paine, Webber & Co., has resigned to accept a position with Hornblower & Weeks, in their New York copper department.

Charles F. Sturtevant, who was for years superintendent of the Cusi-Mexicana mines, has left Salt Lake to take charge of the Jerome-Pacific properties near Jerome, Ariz.

Prof. Heinrich Ries, of the department of geology, Cornell University, is giving a course of ten lectures on non-metallic products in the course on economic geology at Columbia University.

Charles L. Parsons, chief of the division of mining technology of the Bureau of Mines, is on his way back to the United States after a two months' study of processes of nitrogen manufacture in Europe.

Percy E. Barbour, managing editor of the "Engineering and Mining Journal," has returned to New York from Texas, where he has been since July 1, as first lieutenant in the 22d Regiment of N. Y. Engineers, N. G. U. S.

Charles Chynoweth, the well-known mining engineer, has returned from Arizona. He visited the Wolverine & Arizona property at Bisbee, of which company he is secretary. He also spent considerable time at the Jerome camp.

Dr. A. B. Macallum, professor of physiology and biochemistry at the University of Toronto, has been appointed chairman of the recently constituted Advisory Council on Industrial and Scientific Research at a salary of $10,000 a year.

F. B. Gleason, formerly in charge of the Western Electric Co.'s business in the Far East, with headquarters at Tokio, Japan, has been appointed manager of the Southern District of the same company, with headquarters at Atlanta, Georgia.

Edward C. O'Brien, formerly special assistant to the Attorney General of the United States, has resumed the practice of law, having established an office in the Continental and Commercial Bank Building, Chicago. He will specialize in the law of mining, irrigation, water power and Indian lands.

James K. Payne, formerly with Evens & Howard Fire Brick Co., has established an office in St. Louis, Mo., at 2043 Railway Exchange Bldg., to engage in mining and shipping of high-grade Cheltenham fire clays, and to conduct a general brokerage business in refractories under the name of the Retort Clay Co.

L. H. Jones, president of the Detroit Copper and Brass Rolling Mill Co., gave a dinner at the Hotel Biltmore on Dec. 6 to 40 of his friends among the copper and zinc producers and his colleagues in copper and brass manufacturing. Mr. Jones celebrated with this dinner the completion of 35 years in his business.

Charles E. Van Barneveld has been appointed superintendent of the Tucson experiment station of the Bureau of Mines. Dr. Van Barneveld was formerly director of the department of mining of the University of Minnesota. He has specialized in the study of the metallurgical problems of the Southwest and was chief of the Department of Mines and Metallurgy at the Panama Pacific Exposition. Subsequently he served for one year as Professor of Mining at the University of California.

Obituary

Albert C. Einstein, better known as "Fred" Einstein to many old-timers all through the New Mexico mining section, died at his home in St. Louis in the last week of November, following a brief illness. Mr. Einstein was a son of William Einstein, a St. Louis capitalist, and part owner of the Manhattan group of mining claims at Pinos Altos. The son, Fred, was manager of the Pacific mill and the old Aztec mill north of Silver City for several years and was widely known. Mr. Einstein was about 45 years of age and left this section about twenty years ago, engaging in business in St. Louis. He made a fortune out of acetylene lighting systems and was engaged in other large enterprises at the time of his death. Mr. Einstein at the time of his death was president of the Union League Club of St. Louis, and prominent in other civic and social organizations.

Societies

The Mining Engineering and Geological Society of the State College of Washington, affiliated student society of the American Institute of Mining Engineers, gave a luncheon in honor of Dr. Henry Mace Payne. Dr. Payne gave an illustrated lecture on the thawing of frozen gravels to the society.

Engineers' Society of Western Pennsylvania held its regular monthly meeting at the society rooms, Oliver Building, Pittsburgh, on Tuesday, Dec. 12, 1916. A paper on "Blast-Furnace and Steel Mill Power Plants" was presented by R. H. Rice and S. A. Moss, the reading of which was accompanied by the showing of a number of interesting and appropriate lantern slides.

American Institute of Mining Engineers, New York Section.—Second meeting of the season was held on Thursday, Dec. 14, 1916, at the Machinery Club, 50 Church St., New York. The meeting was preceded by a dinner, after which Raymond B. Fosdick spoke on the subject of "Policing a Big City." This is the last meeting of the calendar year, and was attended by a large number of resident and visiting engineers.

Mining and Metallurgical Society of America—The New York Section will hold a meeting at the Engineers' Club on Thursday, Dec. 21, at 8 p.m., preceded by the usual informal dinner at 6:30. The subject of discussion will be "How and to What Extent Have the Costs of Mining, Milling, Smelting and Refining Been Affected by Recent Conditions," and representatives of several branches of these industries are expected to report their experience.

American Chemical Society.—The third regular meeting of the session, which was to have been held jointly with the American Electrochemical Society and the Society of Chemical Industry, on Dec. 8, has, with their consent, been postponed. This meeting will be held in conjunction with the meeting of Section C of the American Association for the Advancement of Science, on Dec. 28, at the College of the City of New York, Professor Stieglitz, Chairman. Members having papers they wish to present should address Dr. J. Stieglitz, University of Chicago, Chicago, Ill.

Mackay School of Mines—The Short Course for Prospectors at the Mackay School of Mines, University of Nevada, Reno, Nev., will be repeated this season. The course will begin on Jan. 8 and last until Feb. 2, thus coming at a somewhat earlier date than on preceding years. The object of changing the opening date has been to make the time most favorable for those wishing to attend, as it has been found in the past two sessions that prospectors like to return to their work about the middle of February, when conditions are likely to be sufficiently favorable, whereas during the month of January it is usually impossible to perform prospecting work.

Geological Society of America and **American Paleontological Society** will hold meetings in the Education Building, Albany, on Dec. 27, 28 and 29. The address of the president of the Geological Society, Dr. John M. Clarke, is on "The Philosophy of Geology and the Order of Research." That of the president of the Paleontological Society, Dr. Rudolf Ruedemann, is on "Persistent Paleontological Types." There will be public addresses by Dr. George Otis Smith, director of the U. S. Geological Survey, on "Geology and Public Service," and by Professor Richard S. Lull, of Yale University, on "The Pulse of Life." There will be symposia on "The Geology of Petroleum" and on "The Interpretation of Sedimentary Rocks."

American Institute of Mining Engineers, Columbia Section.—The sixth annual meeting of the Columbia Section, A. I. M. E., was held at Spokane, Wash., Nov. 25. With Stanly A. Easton, manager of the Bunker Hill & Sullivan Mining and Concentrating Co. in the chair, about 25 members and guests sat down to a six-course dinner, after which Mr. Easton addressed the meeting as retiring chairman. The secretary-treasurer followed with his report, which showed the membership to have increased during the year from 129 to 158. He also read several letters from members who were not able to attend and one from E. Jacobs, who found it impossible to attend, although it was an unusual circumstance. Election of officers then followed, resulting in the selection of Chairman, W. H. Linney, Spokane; Vice-Chairman, Oscar Lachmund, Greenwood, B. C.; Secretary-Treasurer, L. K. Armstrong, Spokane. These, with Stanly A. Easton, past chairman, and S. Sheed, Professor of Geology, Washington State College, Pullman, Wash., form the Executive Committee. J. C. Haas, S. A. Easton and L. K. Armstrong, were appointed a committee on papers.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Air Compressor. Chester A. Herle, Rochester, N. Y. (U. S. No. 1,207,165; Dec. 5, 1916.)

Alloy—Tool-Steel Alloy. Radclyffe Furnes, Jenkintown, and Richard H. Patch, Philadelphia, Penn., assignors to Midvale Steel Co., Philadelphia, Penn. (U. S. Nos. 1,206,833; 1,206,834 and 1,206,902; Dec. 5, 1916.)

Briquets—Manufacture of Briquets of Coal, coke, turf, iron or other ores, or the like. Emil Kleinschmidt, Frankfort-on-the-Main, Germany. (U. S. No. 1,207,180; Dec. 5, 1916.)

Cage—Automatic Safety Mining Cage. George J. Newell, Goldfield, Nev., assignor of one-half to Johnathan H. Frisby, Tonopah, Nev. (U. S. No. 1,207,610; Dec. 5, 1916.)

Cages—Automatic Car-Stop for Mine Cages. John A. Cushman, Terre Haute, Ind., assignor to Frank Prox Co., Terre Haute, Ind. (U. S. No. 1,207,684; Dec. 5, 1916.)

Casting Electrodes—Robert L. Whitehead, Perth Amboy, N. J., assignor to American Smelting and Refining Co., Maurer, N. J. (U. S. No. 1,206,964; Dec. 5, 1916.)

Dipper Buckets—Bail for Dipper Buckets. Ellison Edward Vanderhoef, Ruth, Nev., assignor to American Manganese Steel Co., Augusta, Me. (U. S. No. 1,207,245; Dec. 5, 1916.)

Dipper Buckets—Pulley-Block and Connection for Dipper Buckets. Ellison Edward Vanderhoef, Ruth, Nev., assignor to American Manganese Steel Co., Augusta, Me. (U. S. No. 1,207,244; Dec. 5, 1916.)

Drafting Instrument—Combined Protractor and T-Square. Ralph A. Rohrich, Cleveland, Ohio. (U. S. No. 1,207,328; Dec. 5, 1916.)

Drill—Rock-Drill Chuck. Benjamin Hastings, Cleveland, Ohio, assignor, by mesne assignments, to Sullivan Machinery Co., Boston, Mass. (U. S. No. 1,207,548; Dec. 5, 1916.)

Electrolytic Apparatus. Robert L. Whitehead, Perth Amboy, N. J., assignor to American Smelting and Refining Co., Maurer, N. J. (U. S. Nos. 1,206,963 and 1,206,965; Dec. 5, 1916.)

Electrolytic Recovery—Method of Electrolytically Recovering Metals. William A. Hussey, Oakland, Calif., assignor, by mesne assignments, one-half to James H. Alling and one-half to Francis M. Wright, San Francisco, Calif., (U. S. No. 1,207,048; Dec. 5, 1916.)

Furnace Equipment—Rabble Arm and Rabble for Metallurgical Furnaces. Utley Wedge, Ardmore, Penn. (U. S. No. 1,206,960; Dec. 5, 1916.)

Assessments

Company	Delinq.	Sale	Amt.
Atlantic, Ida.	Dec. 9	Jan. 9	$0.001
Beaver Copper, Utah	Dec. 11	Dec. 30	0.005
Carbonate Keystone, Utah	Dec. 14	Jan. 2	0.01
Century Gold, Utah	Dec. 10	Jan. 10	0.01
Challenge, Nev	Nov. 29	Dec. 20	0.05
Christmas, Utah	Nov. 20	Dec. 16	0.005
Con. Virginia, Nev	Dec. 8	Dec 29	0.05
Eagle Mtn., Ida.	Dec. 22		0.001
East Hercules Ext., Ida.	Jan. 2	Feb. 2	0.0005
Ely-Gibraltar, Nev.	Dec. 15	Jan. 10	0.0025
Emerald, Utah	Dec. 15	Jan. 13	0.00½
Eureka, Ida.	Dec. 9	Jan. 9	0.001
Exchequer, Nev.	Dec. 5	Dec. 27	0.03
Federal Ely, Nev.	Dec. 2	Dec. 20	0.005
Four Timbers, Ida.	Dec. 2	Jan. 2	0.002
Hector, Ida.	Dec. 22	Jan. 16	0.005
Idaho-Nevada, Idaho	Nov. 15	Dec. 16	0.002
Idora, Ida.	Nov. 24	Dec. 23	0.005
Imlay, Nev.	Dec. 19	Jan. 9	0.01
Iron King, Ida.	Dec. 9	Jan. 9	0.001
Mayflower, Ida.	Dec. 23	Jan. 25	0.005
Mexican G. & S., Nev.	Nov. 25	Dec. 18	0.10
National Lead, Ida.	Nov. 25	Dec. 26	0.001
Nevada Zinc, Nev.	Nov. 26	Dec. 16	0.01
New Hope, Ida.	Dec. 11	Jan. 11	0.002
North Franklin, Ida.	Dec. 30	Jan. 22	0.005
O.K. Extension, Utah	Dec. 21	Jan. 10	0.0025
Old Veteran, Ida.	Jan. 6	Jan. 27	0.002
Paloma, Utah	Dec. 12	Dec. 28	0.015
Rarus M. & S., Utah	Dec. 16	Jan. 4	0.00075
Reindeer Queen, Ida.	Dec. 16	Jan. 22	0.005
Sierra Nevada, Nev.	Jan. 4	Jan. 25	0.10
Silver Moon, Ida.	Nov. 25	Dec. 23	0.005
Silver Pick, Nev.	Dec. 2	Jan. 8	0.02
Siavonian, Ida.	Dec. 30	Jan. 20	0.001
Tarbox, Mont.	Dec. 22	Jan. 13	0.005
Tiberius, Ida	Dec. 21	Jan. 12	0.00075
Wallace M., M. & R., Ida.	Dec. 8	Jan. 8	0.0025

The publication of this table will be discontinued after Dec. 30, 1916.

Editorial Correspondence

SAN FRANCISCO—Dec. 6

Damage from Water Infiltration in the Kern River oil fields is mostly caused by comparatively few wells, as shown by data collected by R. P. McLaughlin, oil and gas supervisor of the State Mining Bureau. During the first year of the operation of the department, the engineers were obliged to give most of their attention to the proper drilling of new wells. But the bureau now has an engineer, G. McGregor, employed exclusively in the Kern River field making a complete examination to determine the localities most seriously affected and offering the best opportunities for improving conditions. The opinion has for a long time obtained that little or no improvement could be expected. But one case is recently reported, showing the possibilities in the application of scientific attention to this problem. The Del Rey Oil Co., in coöperation with the bureau, plugged off the bottom water in one well and shut off the top water in another well. There are eight wells in the group; two were repaired, affecting results in four others. There was an increase in the production of five wells and decrease of water in five wells. The total production of the eight wells was increased from 135 bbl. to 207 bbl. daily, and the water was reduced from a daily flow of 1,750 bbl. to 121 bbl One well had no production prior to the repair, but produced 7 bbl. of oil, 5 bbl. of water daily, after the repair. Another well having a daily production of 10 bbl. of oil and 1,500 bbl. of water increased in oil production to 40 bbl. daily and the water declined to 15 bbl. a day. Operating costs were also reduced by dispensing with a compresor for handling water. The results have also benefitted adjoining and neighboring wells, and shaken the disbelief of the skeptics.

Restriction of Hydraulic Mining, by Federal and state laws, in counties and districts where streams may be permanently affected has been in operation for 33 years in California and all infringement of the law is speedily punished. But during all these years that the hydraulic miner has been denied the right to mine his gold, there has been no adequate remedy applied by the nation or the state. Large amounts of Federal and state money have been expended in reclamation of land for the benefit of the farmers and the restraining of flood waters, but no effort has been directed toward the double purpose of protecting the farmer and compensating the miner. Hundreds of hydraulic miners have been forever deprived of the gold in their lands, because they are either dead or in the almshouses through poverty entailed by the loss in the value of their property. If the money that has been expended uselessly in flood control had been devoted to the construction of dams and reservoirs for the conservation of water and impounding of tailings a large aggregate area of hydraulic-mining ground could have been reclaimed and the production of gold greatly increased, to say nothing of the saving of the fortunes of men as justly entitled to results of their investments and labors as are the farmers. But the state and the Federal Governments have left it to the hydraulic-mine owner to protect himself and build his own dams and reservoirs. It would have been a crime to destroy the land of the farmer; but apparently it was considered just to deprive the miner of the right to mine his gold without an effort to assist him. There are counties and districts in the state, of course, where hydraulic mining has not been interfered with, but the total production is so small and the number of operating mines so few that the industry is insignificant compared to the results of gold mining by other methods. In 1915 the total production of gold in California was 1,085,646.05 fine oz., valued at $22,442,296. Of this amount $420,770 was produced by 96 hydraulic mines, which amounts to 4.89% of the total placer gold. The dredges, drift mines and other placers produced $8,187,947 of an aggregate placer production of $8,608,617.

BUTTE—Dec. 7

Exploitation of Zinc Resources of the Butte camp has received a new impetus by the announcement that the Davis-Daly company is contemplating a vigorous development of its extensive holdings in the zinc section of the camp. Under the present energetic management a beginning has already been made and an agreement entered into with the Butte-Detroit company to handle at its Ophir mill the Davis-Daly zinc ores, now being extracted from the developments carried on in search of new bodies of copper ore. Davis-Daly owns about 400 acres of mineral ground under the city of Butte and surrounding territory, only five or six acres of which have been explored. Seventy per cent. of this area is in what is regarded as the zinc area of the district and it is in this territory that the company's chief energies will be expended in opening up its zinc resources that have lain unprospected these many years for want of a market and treating facilities. Should the expectations of the company be realized, Butte may see before long another important zinc producer added to the Butte & Superior, the Elm Orlu and the Anaconda company zinc mines, and, no doubt, new mills to handle the output.

An Important Copper Development was made recently by the Tuolumne company, which opened 10½ ft. of commercial ore in the Butte-Main Range group in the eastern section of the district. Much local excitement was created by the opening of this orebody and the possibilities it suggests for the eastern section of the Butte district. Manager Paul Gow has given out the following report: "The orebody which has been encountered at the end of the crosscut on the 700-ft. level of the Sinbad in the Spread Delight vein is believed to be a continuation of the Leonard ledge. As far as opened up to date it shows 10½ ft. of commercial ore and an assay of five samples taken clear across gives an average showing of 5.1% copper and 15 oz. of silver to the ton. The orebody has been developed for a distance of 95 ft. and the foot wall has not yet been disclosed. The hanging-wall fissure of the Spread Delight vein is 20 ft. wide, 12 ft. of which is well mineralized and 4 ft. of it commercial ore. This is followed by a horse of altered granite 45 ft. wide containing a number of seams showing good copper values. To the south of this horse of granite, the vein fissure has been opened for a width of 30 ft. and mineralized throughout with 10½ ft. of commercial ore and the foot wall not in sight." The vein is supposed to traverse the Main Range group for 1,400 ft. and the westward continuation may cross the Colusa-Leonard group. Already plans are under way to crosscut on the 700-ft. level from the Colusa-Leonard shaft. In this same general district development work is carried on by the North Butte, the Anaconda, the Bullwhacker and other companies some of which have already reached the shipping stage. Altogether the prospects of adding materially to the copper resources of the camp by the work now being carried on in the eastern section are growing brighter every day.

DENVER—Dec. 7

Ohio & Colorado Smelting and Refining Co. has, during the past year, smelted at Salida an average of 386 tons of raw ore per day, according to a reported statement by E. H. Laws, the superintendent, before a luncheon of Salida business men. The gross furnace charge has averaged 510 tons daily. The products therefrom have averaged 42 tons of base bullion and 7.5 tons of leady copper matte. Most of the ore originates in Colorado, but some lead ore is imported from Idaho districts. The company is capitalized at $3,000,000. Last year it paid out in the purchase of ores $2,980,000, while the freight amounted to $445,000. Coke, manufactured at Trinidad and Crested Butte, cost $132,000. Coal, mined at Somerset and Crested Butte, cost $16,750. Limestone purchases amounted to $27,000. Electrical power was purchased for $25,750. Supplies and repairs are figured in at $56,500. The cost of shipping to and refining the products in Eastern works amounted to $272,000. The average payroll per month was $19,944, while salaries amounted to about $2,000. An average of 252 men was daily employed about the works and the average wage per shift was $2.534. The plant cost $965,000 and is assessed for taxation at $455,000.

LEADVILLE, COLO.—Dec. 8

Leadville Miners Get Wage Increase beginning Dec. 1. The disturbed labor situation, which has been a source of concern to the mine operators of the district for a period of several months was settled Dec. 5 when the large companies announced an increased pay schedule for their employes taking effect Dec. 1. Miners, trammers, shovelers and topmen who have been paid at the rate of $3.30 a shift have been raised 20c. to $3.50 a shift, the lowest wage now being paid in the mines of the district. Timbermen, machine men, and expert workmen who have been receiving $3.85 a shift have been raised 15c. to $4 a shift. Hoist engineers, mechanics and others who have received $4.40 a shift have been raised 10c. to $4.50. The new schedule is a uniform increase of 50c. a shift to all mine employees above the scale of wages in force prior to last April. The action on the part of the mine operators followed a petition filed with the state industrial commission by the local miners' union, asking an investigation of laboring conditions in the district with a view to securing a raise in wages for the men. The commission was to have arrived in the district on Dec. 5, but owing to the absence of one of the body, it was stated that the date of investigation had been postponed to Dec. 15. The operators then got together and considered the wage question from all angles, finally coming to the conclusion that under existing conditions an increase was justified and it was announced to the men when issuing pay checks Dec. 5. The increase is to continue in force until further notice and is not stated to be based on the market price of any metal.

SALT LAKE CITY—Dec. 8

Statistics on Utah Mine Production in 1915 have been completed by Victor C. Heikes, of the U. S. Geological Survey. The total amount of ore produced was 10,451,445 short tons, as compared to 8,544,014 short tons in 1914. These ores carried: Gold—including small placer production—$3,609,109; silver, 12,313,205 fine oz.; copper, 187,671,188 lb.; lead, 199,967,437 lb.; zinc, 24,292,240 lb. The total value of the output was $55,105,070, as compared with a total value of $37,151,593 in 1914. The value of Utah's metal output from 1864 to 1915 is given at $727,558,498.

Salt Lake Valley Smelteries are running at capacity, as has been the case the greater part of the year. The United States Smelting Co. at Midvale is running five furnaces on lead ores. The American Smelting and Refining Co. at Murray has five or six furnaces treating lead ores. The Garfield Smelting Co. of the A. S. and R. operated four blast furnaces and five out of six reverberatories on copper ores. To this plant were added two more converters as well as 10 new Herreshoff roasters. The International at Tooele has five lead furnaces in blast, operating its lead plant at capacity; four out of the five copper reverberatory furnaces are in operation. Among other improvements, Cottrell apparatus has been installed taking all of the sintering plant (Dwight-Lloyd) gases, and also a separate Cottrell plant at the converters to treat all of the converter gases. Practically all of the camps in the surrounding country are making increased shipments and a large tonnage of ores is being received by the Valley smelters. The restrictions placed on certain classes of ores from Tintic and elsewhere in the middle of the year have been removed.

Garfield Chemical and Manufacturing Corporation, which has been building a new sulphuric-acid plant at Garfield, began warming up Dec. 1. The initial capacity will be 100 tons of sulphuric acid daily. The chamber process will be used, and gases from some of the new Herreshoff roasters of the Garfield smeltery will be utilized. The company is a separate corporation, however. The plant was built primarily to furnish acid for the new leaching plant of the Utah Copper Co., now in process of construction and expected to be completed about the middle of next year, June, 1917. Acid is also used in this section in flotation and in oil refining, and there is a probability that a large amount of it may be used in the future in the manufacture of fertilizer from phosphates, of which there are large high-grade deposits in Utah, southern Idaho and Wyoming. The new plant will produce three grades of sulphuric acid: 60° Bé, 66° Bé. and 98% sulphuric acid. It will be able to produce as high as 150 tons of acid daily, and provision has been made to further increase the capacity if desired. The buildings and plant are practically completed and regular production will begin about Dec. 15.

MASON, NEV.—Dec. 5.

Resumption of Mason Valley Smeltery, recently ordered, has greatly stimulated the activity in this district, though several months may elapse before the reduction works at Thompson will actually be ready to begin smelting. A contract is reported to have been entered into between the Mason Valley Mines Co. and the Bluestone Mining and Smelting Co., belonging to Captain Delamar, whereby the Bluestone is to ship 500 tons of ore per day to the Mason Valley smeltery by some time in April, increasing this tonnage to 1,000 tons per day by June. The Mason Valley company is preparing to mine 500 tons a day from its own mine near Mason by the middle of June. Surveys have been completed on a standard-gage Shay line, 2.2 mi. long, connecting the Bluestone mine with the main line of the Nevada Copper Belt R.R. at Mason, Nev. This line will be calculated to handle the tonnage, which is to be shipped from the Bluestone property. The Nevada-Douglas Consolidated Copper Co. has just started its leaching plant at Ludwig and is preparing to ship a considerable tonnage of ore to the Mason Valley smeltery. A portion of this ore will be produced from its mine at Ludwig, and some from the Western Nevada property near Mason. The Nevada-Douglas company is also considering the installation of a flotation plant at the Western Nevada, the ores of which consist mostly of iron and copper sulphides occurring in a siliceous gangue, and are amenable to concentration by oil flotation, and at least one ton of concentrates should be obtained from each

four tons of ore treated. Besides these major properties, the smaller mines and prospects of the district are all making plans for increased activity as soon as an outlet for their ore is again available.

WALLACE, IDAHO—Dec. 6.

Increased Milling Facilities are required by the Morning mine at Mullan, owned by the Federal Mining and Smelting Co., and arrangements are being made to provide a total capacity of 2,000 tons per day. The Mammoth mill at Wallace, also owned by the Federal, 7 mi. from the mine, is being remodeled and a flotation plant added which will increase its capacity from 450 to 500 tons, the changes providing for the recovery of zinc as well as lead, the Morning now producing considerable zinc. The Morning is developed 1,000 ft. below the working tunnel, and the large ore reserves opened on every level have rendered larger milling capacity necessary, the Morning mill alone having a capacity of 1,500 tons. An addition is also being made to the sorting plant to correspond to the increased output. It is expected that the changes in the Mammoth mill will be completed by February.

Success Wins Apex Case against Alameda in the Idaho Supreme Court, which reversed the ruling of the district court. An appeal in the Alameda-Success case will be taken to the Federal court, according to a statement made by one of the directors of the Alameda company. Conforming to the decision in the lower court, a referee had been appointed to determine the value of the ore extracted by the Success company from Alameda ground and fix the amount to be paid by Success, the court holding that the Success had no extralateral rights extending into the Cardiff claim of the Alameda, and that the Alameda should be reimbursed for ore extracted. The referee found the amount due the Alameda to be $56,000 and had just submitted his findings to the district court for review when the supreme court handed down its decision reversing the judgment. Since the decision in the district court, the Alameda company has been reorganized and financed and a long crosscut is being driven for the purpose of working the ores which the supreme court now says belong to a large extent to the Success.

HOUGHTON, MICH.—Dec. 8

Bonus for Copper Miners who have worked steadily for the last six months will be paid by the Lake copper companies. Approximately 17,000 of the 25,000 employees of copper mines in the Lake Superior mining district will participate in the bonus distribution on the first pay day in January, 1917. This bonus was announced last summer. It is additional premium, over the regular increase in wages, of 25c. for every day for every employee who worked from July 1 to Dec. 31. Employees who quit during that time do not participate, but an examination of the records indicates that the percentage of men who quit is insignificant. The bonus payment at the Wolverine and Mohawk mines will be made on Jan. 15, the regular pay day. At the Calumet & Hecla, La Salle, Ahmeek, Allouez, Kearsarges, North and South, old Osceola, Superior, Isle Royale, White Pine, Centennial, Hancock and Tamarack mines the bonus will be paid on Jan. 13. The mills will pay the day before. At the Quincy mine and mill the bonus will be paid on the first pay day in January, and also at a number of the smaller mines where the system is in operation. It is generally assumed that all of the companies that operated under the bonus system for the six months closing the present year will soon make an announcement offering a similar bonus for the first six months of 1917, or for such period as the high price of copper is maintained.

Tamarack's Production for December and November will equal if not better its October record. The output for the last two months of 1916 can be estimated at 1,200,000 lb. The company is operating three shafts. No. 3 and No. 5 are furnishing a fair grade of conglomerate, and No. 2 is getting out nothing but amygdaloid, but it is profitable mining at present. No machinery has as yet been installed in the regrinding plant at the mills. This building was completed last summer and is to handle sands. It has been found impossible to secure delivery on the necessary machinery excepting at unusually high figures. While the property now is operating at a profit, costs are high and it is difficult to secure good miners for the work in the lower conglomerate formations where ventilation is not so good.

JOPLIN, MO.—Dec. 9

Strike of Shovelers at the Gibson mine in the West Joplin camp during the week was of short duration. Thirty-five men walked out on a demand for 12c. a can instead of 11c. Later they became convinced 11c. was fair and most of the men returned to work the next day.

Sarcoxie's Only Operating Mill was burned last week with a reported loss of $40,000. The mill, which was owned by the Flannery Zinc Co., was of 400 tons capacity and one of the best in the district, being equipped with three Diesel oil engines. Only two of these were injured, however, and these only to the extent of about $1,000 each. The remainder of the plant was a total loss. There was $15,000 insurance. This mine has been the only one operating in the Sarcoxie camp for months. About 200 men were employed and many of these already have gone to the Oklahoma field in search of work. Walter F. Friday, manager of the plant, was away on his honeymoon at the time of the fire. J. L. Flannery, of Pittsburgh, Penn., is principal owner of the property. It is expected the plant will be rebuilt, though no definite word has been received.

The Boom in Baxter Springs Section was accentuated last week by the bringing in of another rich drill hole immediately south of the Town of Baxter Springs, Kan. In the last year this town has increased in population from 1,500 to 2,800, and indications point to an increase of another thousand in the next six months. When it was announced that the Southwest Missouri Railway Co. would extend its lines from Galena to Baxter and that A. H. Rogers, president of the company, already had purchased considerable property in the new terminus of the Carthage-Joplin-Galena line, there was a rush to buy property. All during the last summer drilling operations tended to prove the extension of the Picher-Century-Cardin ore run toward Baxter, and now it has been proved right to the town limits. The latest strike shows a rich run of blende at a depth of only 140 ft.

WASHINGTON, D. C.—Dec. 9

Revision of the Mining Laws is to receive prompt attention by the committee on mines and mining of the House of Representatives, according to Dr. Martin D. Foster, the chairman of the committee. The matter first is to be considered by a subcommittee, consisting of Dr. Foster, Edward T. Taylor, of Colorado; Frank W. James, of Michigan; Courteney W. Hamlin, of Missouri, and James Wickersham, of Alaska.

TORONTO—Dec. 8

Tax on Mining Claims will be increased by a recent ruling of the Ontario Railway and Municipal Board. A test case, brought by the Township of Tisdale in the Porcupine area against the Foley-O'Brien Mining Co., resulted in a decision upholding the municipality in assessing the mining lands on the same basis as farm lands, the valuation being $35 per acre. An appeal was taken to the Ontario Railway and Municipal Board and the decision of the judge was confirmed. As a result, mining lands that have been held idle by speculators for years, being subject to increased taxation, will either be worked by the owners or put on the market at reasonable prices.

The Mining News

ALASKA

MOTHER LODE COPPER MINES CO. (Kennecott)—Announces acquisition of Houghton-Alaska claims, 180 acres adjoining Mother Lode and Kennecott properties.

ALASKA GASTINEAU (Juneau)—Milled in November, 167,600 tons; heads, $1.13; extraction, 81.71%; tails, 20 7c. In October milled 158,000 tons; heads, $1.32.

ALASKA MINES CORPORATION (Nome)—Ellis E. Powell, Western managing director, quoted as saying that company will construct, in addition to dredges already ordered, a gigantic dredge—a "yard boat"—with buckets of 27 cu.ft. capacity. The largest buckets now used on a gold dredge have approximately 17 cu.ft. capacity.

ALASKA MEXICAN (Treadwell)—Mill ran 17 days 20½ hr. by water power in October, crushing 12,635 tons for average yield of $1.18 per ton, or $14,776; operating expenses, $14,260; operating profit, $516; construction expenses, $5,045; estimated loss, $4,528; other income, $3,783. Amalgamation has been discontinued, gold now being collected entirely by concentration.

ALASKA UNITED (Treadwell)—In October, Ready Bullion mill crushed 24,374 tons and 700-Ft. Claim mill 24,360 tons for an average yield of $1.46 and $1 25 respectively, or $35,311 and $30,-179. Ready Bullion operating expenses, $35,759; operating loss, $447; construction, $6,411; total operating loss, $6,859; net value of copper plates, $23,279; other income, $1,940. The operating expenses of 700-Ft. Claim section were $63,882; operating loss, $33,702; construction, $8,591; total operating loss, $42,293; net value of copper plates, $14,288; other income, $1,940.

ALASKA TREADWELL (Treadwell)—In October ran 150 stamps in the 300-stamp mill, crushing 26,362 tons for average yield of $2.13, or $55,699; operating expenses, $30,380; operating profit, $25,319; construction expenses, $16,735; net operating profit, $8,584; net value copper plates, $32,517; other income, $11,521; total profit, $52,623. Stock of broken ore decreased 16,107 tons. Central and combination development now included in "Construction Expenses" instead of "Operating Expenses" as heretofore in reports of all three Treadwell companies.

ARIZONA

Cochise County

SHATTUCK-ARIZONA (Bisbee) — November production was 1,535,723 lb. copper, 458,153 lb. lead, 22,531 oz. silver and 282.39 oz. gold. Eleven months' copper production, 16,742,424 lb.

Gila County

MIAMI (Miami)—November production, 4,968,-500 lb. copper. In October, 4,859,400 lb.

OLD DOMINION (Globe)—November copper output about 3,650,000 lb. In October, 3,200,000 lb.

INSPIRATION (Miami)—November copper output, 10,600,000 lb.; October production, 11,300,000 lb. Daily mill capacity will be 18,000 tons on completion of two units now being installed.

Greenlee County

SHANNON (Clifton)—November copper output, 926,000 lb., as against 757,000 lb. in October. Grade of ore improved lately, especially in the Alaska.

Mohave County

BULLION GROUP of claims in Chloride sold by A. W. Wright to Utah men; adjoins Georgia mine.

METALLIC ACCIDENT (Chloride)—Copper orebody being opened in this property, recently acquired by Gus Holmes and associates.

TENNESSEE (Chloride)—Raise from 1,400-ft. to upper levels expected to hole through soon, when working force will be increased.

Pima County

CREPIN GROUP, about 20 mi. from Sasco smeltery, has been acquired by John F. Cowan, of Salt Lake City, Utah, for Tucson-Arizona Copper Co., a new corporation capitalized at $1,000,-000 in $1 shares; 600,000 shares pooled, 400,000 in treasury. Ore carries some silver as well as copper.

BISBEE-AJO COPPER AND DEVELOPMENT (Bisbee)—This Bisbee company is sinking a two-compartment shaft at its property in the Ajo district; shaft 100 ft. in oxidized iron capping. Machinery being installed. Edward Sweeney, of Bisbee, president.

Yavapai County

PITTSBURGH-JEROME (Jerome) — Preparing to crosscut on 700 level; shaft now down 850 ft.

VERDE COMBINATION (Jerome)—This property, between Smith group and Copper Chief Extension, is being developed by tunnel.

VERDE APEX COPPER MINING CO. (Jerome)—Being refinanced, preparatory to development. J. E. Robinson, secretary, Prescott, Ariz. Property southeast of Verde King.

BIG JEROME COPPER CO. (Jerome)—Another new copper company floated by Los Angeles men. Harry E. Andrews, of Los Angeles "Times," vice-president. Property comprises about 640 acres adjacent to Pittsburgh-Jerome.

UNITED VERDE CONSOLIDATED COPPER CO. (Jerome)—E. M. Longyear Co.'s drilling crew and machines have arrived and will do 6,000 ft. of drilling by contract on the Mahurin tract; the Wilson company's contract for 2,000 ft. of drilling is on the United Verde Junior group.

GADSDEN COPPER CO. (Jerome) — Incorporated in Delaware with $1,000,000 capital in $1 shares to take over the Calumet & Arizona options in this district. Understood that 300,000 shares will be issued for the properties and that C. & A. will hold option on the remaining 700,-000 shares, and is obligated to sink one shaft and do other exploratory work costing approximately $100,000. Properties controlled included the News, Larrimore, Howe and Sutter-Larson groups.

Yuma County

UNITED MINES CO. OF ARIZONA (Bouse)—Recently shipped to smeltery car of copper-gold ore and plans to erect 50-ton mill to treat gold ore from another portion of property. Preparing to ship copper ore from No. 2 level while sinking shaft, now 380 ft. deep, to 700 or 800 ft.; four 6-hr. shifts to be used in this work. Churn drilling also being started. Other equipment includes two 350-cu ft. compressors, hoist, pump, etc.; another hoist also ordered. Railroad siding to mine being finished. S. T. Godbe, of Los Angeles, Calif., consulting engineer; J. C. Denton, president and manager.

CALIFORNIA

Amador County

ONEIDA (Sutter Creek)—New orebody disclosed in 2,600 level; 20 stamps dropping. Rapidly resuming normal conditions.

KENNEDY (Jackson)—Men being added to underground force as rapidly as mine can be prepared to utilize their labor; deepening shaft again in progress; installation of three new Erie boilers interrupted by the labor strike has been resumed; Bent Bros., of Los Angeles, have comuleted raising of tailing dam to a total height of 50 ft.

Inyo County

TUNGSTEN MINES AND MILLS at Bishop are in steady operation. The Tungsten Mines Co. and the Standard are employing about 120 men.

SILVER-LEAD ORE taken out by Thomas Tait and Edward Smith ready for shipment; discovery made about two months ago on eastern slope of White Mountain, 16 mi. from Big Pine. Ore said to run 40% lead and 12 to 16 oz. silver.

ALVARADO (Bishop)—Shipping ore disclosed in 70-ft. tunnel.

SANTA ROSA (Keeler)—Reported 100 tons high-grade zinc ore shipped weekly; more ready for shipment; hauled by motor truck over 26-mi. road to railroad at Keeler.

NOBLES (Round Valley)—Cooper Shapley has secured an option on this tungsten property and will immediately begin active exploration and examinaton. Property developed by opencuts. Numerous croppings exposed on hillside. Mill may be erected.

FIFTY ASSOCIATES SECURITIES CO. (Los Angeles)—Large body of talc being developed near line of Tonopah & Tidewater R.R. After stripping overburden, deposit will be bored with coal augers and blasted with black powder. Deposit extends into San Bernardino County.

Kern County

EAGLE HILL (Genesee)—New galena and blende orebody reported by W. W. Adams, operating under bond from G. H. Goodhue.

BIG FIFTY (Caliente)—Large vein of stibnite opened in porphyry dike. Shipping about 4 tons daily of 30% ore. F. W. Remy, of Los Angeles, consulting engineer.

Nevada County

GRASS VALLEY BOUNDARY (Grass Valley)—Company permitted to sell 75,000 shares at 35c. for development of the Oak Tree lode, near old Peabody mine.

ALLISON RANCH (Grass Valley)—Company has negotiated for property owned by Lewis and Henderson estates, embracing 53 acres, including the Great Eastern, New Idea and Golden Cycle claims. Has been stated that the Caribou vein apexes in this ground.

MOHEGAN (Nevada City)—Property on Gold Flat bonded to A. J. Burke, San Francisco. Pumping and hoisting plant at the Mount Auburn mine being installed here; electric power line from Pittsburgh mine will be constructed. J. C. Campbell is manager.

Placer County

IOWA HILL DISTRICT active from chrome developments. The Golden Streak gravel mine will be reopened by Colfax men. Tailings from the famous Big Dipper, Morning Star and Jupiter mines in Rose and Schwab Cañons will be worked by Chinese miners from Dutch Flat.

Plumas County

WALKER COPPER (Portola)—Mill crushing about 65 tons daily; concentrates hauled by team to Gulling, on the Boca & Loyalton R.R., for shipment to smeltery at Salt Lake. No decision reached regarding extension of railroad to the mine.

COPPER BONANZA (Portola)—This property of 12 claims, recently located near Walker mine by Bert G. Pershal and associates, is said to present fine copper showing and apparently in the same formation as the Walker and the Engel mines.

COLORADO

Boulder County

PRUSSIAN (Boulder)—Mine and mill started by Boulder men.

PRIMOS CHEMICAL CO. (Lakewood)—New schedule for tungsten ores announced: For ores running 40% tungsten or under, $10 per unit; 25c. additional per unit for over 40%. Renewal of leases announced and ore will be purchased on open market.

Chaffee County

TURRET COPPER MINING CO. (Turret)—Stated 12-ft. vein shipping ore opened on 200-ft. level. Some good-grade ore mined on upper levels. F. B. Radow, manager.

PARAMOUNT REDUCTION CO. (St. Elmo)—New custom milling plant nearing completion; equipped with crusher, ball mills, concentrating tables and flotation machine. Mixed sulphide ores from district will be treated about Jan. 1.

Gilpin County

BELDEN TUNNEL (Central City)—Lessees shipping ore to Polar Star mill.

GILPIN-EUREKA (Central City)—Shipping high-grade concentrates to Globe smeltery, Denver.

TWO BROTHERS (Russell Gulch)—Breaking of compressor necessitated shutting down of this property and Trio tunnel.

RARE METALS ORE CO. (Rollinsville)—Mill running three shifts on custom tungsten ore; making good recovery; capacity 75 tons per day. S. B. Tyler, superintendent. Company's own mine will soon be producing ore. Nelson Franklin, manager.

Jefferson County

GREAT WESTERN PORTLAND CEMENT CO. incorporated for $500,000; subsidiary of Cement Securities Co., Chas. Boettcher, president. Incorporators are: R. J. Morse, Clark M. Moore and Harry O. Wasmer, all of Denver. Plant to cost $750,000, to be built near Morrison. Chief field to be supplied will be Wyoming, South Dakota and northern Colorado.

Lake County

DERRY RANCH GOLD DREDGING (Leadville)—Dredge shut down on Dec. 8; cleanup for season approximately $130,000.

Ouray County

MOUNTAIN TOP (Ouray)—What is said to be the first complete underground mill in the world has been built in this property at a point 1,000 ft. in from portal of the tunnel. Capacity of plant is estimated at 50 tons and the cost $100,000. Equipment includes ore bins, crushers, concentrating tables, ball mill and flotation apparatus. Operators will no longer fear snowslides, which have hindered operations in the past.

San Juan County

NOVEMBER SHIPMENTS from Silverton were: Sunnyside, 28 cars; Gold King, 22; Silver Lake mill, 15; Iowa-Tiger, 14; Mayflower lease, Silver Ledge and St. Paul, 8 each; S. D. & G. lease and Congress, 7 each; Koehler tunnel, 5; Highland Mary, 4; Dives lease, Mears-Wilfley and Hamlet, 3 each; Kittimac and Atlantic lease, 2 each; Intersection, Davey Leasing Co., Gennessee, Carbon Lake, Jumbo lease, Averill and Vernon, 1 car each; and miscellaneous small shipments aggregating 13 cars; total, 159 cars. Producers shipping ore to Silver Lake custom mill were: Green Mountain, 24 cars; Davey Leasing Co., 18; Allen & Fattor and Congress, 4 each; Ben Butler, 1 car; total, 51 cars.

COMING WONDER (Silverton)—This Anvil Mt. property being developed by Nels Andrene and associates.

San Miguel County

NOVEMBER SHIPMENTS from Telluride were: Tomboy, 63 cars; Smuggler-Union, 33; Liberty Bell, 16; Anderson, 2; Carlson and King & Ferrell, 1 car each; total, 116 cars, mostly concentrates.

BUTTERFLY (Ophir)—Development being done by Jurich Leasing Co. Occasional mill runs made on ore produced from development.

TOMBOY (Telluride)—Mill ran 28 days, crushing 12,000 tons, yielding $37,000 in bullion and $59,000 in concentrates; operating expenses, $68,000.

Summit County

ORE DISCOVERIES made recently in New York, Baker, Roby properties on Gibson Hill and in Old Union and Ben Benson's lease on Washington mine.

SILVER BOWL (Kokomo) — Ore shipments started.

LITTLE EDITH (Breckenridge)—Lead ore opened in lower tunnel on Bald Mountain.

WELLINGTON (Breckenridge)—New shaft being sunk just below mill to explore Oro vein, opened in dredging operations and which has been good producer in distant part of property. Shaft to be sunk 100 ft., then crosscutting. Addition being built at mill to provide increased flotation capacity.

BOLIVAR MINING AND TUNNEL TRANSPORTATION CO. (Montezuma)—Stated Boston men will finance continued development and increase capacity of mill. Negotiations under way to bond several other properties in district. Engine and fan to ventilate No. 1 tunnel will be installed and driving resumed; tunnel will afford transportation and drainage facilities to several mines now practically inaccessible.

Teller County

DEXTER (Cripple Creek)—Lessees shipping high-grade ore.

ECLIPSE (Cripple Creek)—Regular shipments good-grade ore being made.

BLUE BIRD (Victor)—Lessees are hand-sorting and screening the dump and securing payable grade of milling ore.

BONANZA KING (Victor)—Being developed by Midget Bonanza Gold Mining and Milling Co. Electric hoist installed by lessees.

GREGORY (Cripple Creek)—Dump on Raven Hill being shipped by A. E. Carlton and associates. Aërial tramway built to transport material to railroad.

CRESSON (Cripple Creek)—Company reports October profits $154,476, with cash in bank $1,215,791, and 81 cars of ore in transit worth $75,000.

GOLD DOLLAR (Cripple Creek)—Rich strike made on 400-ft. level of Mable M. shaft by Hill & Coughlin, sublessees of Union Leasing Co. Ore is quartz and granite carrying calaverite; opened for distance of 20 ft.; assays $50 across width of 2½ ft.

IDAHO

Custer County

EMPIRE COPPER (Mackay)—The new interests, L. R. Eccles and associates, of Ogden, Utah, have assumed management of this property; will increase output to 700 tons daily and plan to erect new reduction plant in spring. Good body of sulphide ore encountered in Cossack tunnel, about 900 ft. below the Alberta tunnel. Manager Adkinson will drive raise from Cossack to Alberta tunnel and eliminate the use of the "Shay" railroad; two new compressor plants ordered, new laboratory also to be built. Company has been shipping 250 tons daily to Garfield (Utah) smeltery. Fred L. Vahrenkamp, managing director.

Shoshone County

BIG IT MINING AND MILLING CO. (Beeler)—New incorporation to develop group in Pine Creek section. C. M. Beeler, M. L. Pratt and C. R. Konkle interested.

HECLA (Wallace)—Addition to Hecla mill at Gem about completed, increasing capacity from 450 tons to about 700; company also negotiating for a lease on the Marsh 200-ton mill on Nine Mile Creek.

HUNTER (Mullan)—Preparations being made to sink from 1,200 level. Ore on this level rather disappointing, which led to thorough prospecting of ground below with diamond drill. Preparation to sink taken to mean that diamond drilling proved satisfactory. Main vein, lead-silver; parallel vein carries high silver but no lead. Attempts to treat ore from both veins in same mill proved unsuccessful; different flotation adjustments required to recover the lead and silver. Company considering building new mill next year for lead ore and transforming old mill into flotation plant for high-grade silver ore.

MICHIGAN

Copper

SUPERIOR (Houghton)—Sending out about 575 tons of rock daily.

ISLE ROYALE (Houghton)—Drifting south of No. 7 shaft. Foundations ready for new rockhouse at No. 7 shaft.

COPPER RANGE (Painesdale)—Has three diamond drills working in a tract south of the Globe; land under option from the St. Mary's company.

CENTENNIAL (Calumet)—No. 2 shaft has reached the 18th level. Drifting from No. 1 shaft past No. 2 shaft, north, the ground has shown good mineralization.

HOUGHTON (Houghton)—Discontinued northern drift on the 12th level, because of the excessive cost of operating same. Good rock being stoped on sixth level.

CHEROKEE (Houghton)—Vein crosscut, at a depth of about 120 ft., for 29 ft. One drill will continue operating in east drift; two drills will be kept on sinking.

NEW BALTIC (Houghton)—Owing to large amount of water, sinking is proceeding slowly; shaft down about 60 ft. Delay in part due to slow shipments of supplies.

ALLOUEZ (Allouez)—Contract let for five 4-ton electric locomotives for underground haulage on the 14th, 15th, 16th, 17th and 20th levels. The hauls will be approximately 2,000 ft. each.

KEWEENAW (Mandan)—Conditions somewhat improved. About 40 bbl. of "mineral" and two carloads of mass copper shipped to Quincy mill during recent week. Have men enough to supply rock for the mill to run all the day shift.

HANCOCK (Hancock)—Improved labor supply has resulted in increased tonnage. Winze from 49th to 53d level nearly completed, while that from 44th to 49th level has been completed.

SENECA COPPER CO. (Calumet)—Lewisohn Bros., of 11 Broadway, New York, and Tucker, Hayes & Bartholomew, of Boston, have formed this company with 250,000 shares to take over the old Seneca Mining Co., a subsidiary of Calumet & Hecla.

Iron

LAKE ANGELINE (Ishpeming)—Ore of fine grade uncovered by stripping. The shovel work being done by contract; owners are operating a dragline excavator. Expected to ship about 100,000 tons next year. It was believed ore was exhausted, mine having been sold at auction last year for $27,000. Cleveland-Cliffs Iron Co. were purchasers. Drills disclosed several bodies of ore close to surface. Ore always considered finest in district.

MINNESOTA

Messabi Range

OLIVER IRON MINING CO. (Chisholm)—Orders given to proceed with stripping work at Glen mine. Also on lands known as the Bliss and Burt property, which the Hartley mine encompasses. Means the removal of 1,000,000 cu.yd of overburden from Glen and 1,500,000 cu.yd from other property. Shovels and men transferred recently from Burt-Leonard pit to Glen. Two shovels to work two shifts. Six locomotives will be employed. Similar equipment will be at the other pit. These two mines together should ship 1,000,000 tons of ore next year.

MISSOURI-ARKANSAS

Joplin District

GRAND HAVEN (Joplin)—Being reopened by Asquith & Berlin, of Joplin. Recent drilling shows good ore southeast of mill.

R. L. McGEE—(Duenweg)—Purchased Zogg land lease near Diamond and begun construction of small mill. Silicate mine, with operations at 80 ft.

BALTIC (Duenweg)—Owners recently leased ground to the superintendent on contract. Three carloads of concentrates made weekly since contract went into effect.

COAHUILA (Duenweg)—Again operating its No. 1 and No. 3 mills at Duenweg and No. 2 plant at Carthage, and making big weekly output. C. A. Smith, district manager, still on Mexican border as major in Missouri National Guard; R. C Bean, acting manager.

Northern Arkansas

BEATTY (Kingdon Springs)—Sold by State Senator Killam, of Locust Grove, Okla., to Wade Luckett and associates, of Rush. Consideration $30,000. Property is blende producer only, which is unusual for Arkansas field. Good showing at 40 ft. Mill recently overhauled and put in good condition.

MONTANA

Granite County

NANCY HANKS-MONTANA MINING CO. (Garnet)—New organization to operate the old Nancy Hanks gold-copper mine. Property comprises 8 claims and main shaft is down 400 ft.; equipment capable of sinking shaft to 600 ft. J. E. Blanc, 90 Wall St., New York, president.

Silver Bow County

EAST BUTTE (Butte)—November copper output 1,648,000 lb. In October 1,650,000 lb. Copper production for 11 months, 17,101,540 lb.

BUTTE & SUPERIOR (Butte)—Mined in November 54,312 tons of ore and milled 53,880 tons, producing 14,300 tons of concentrates, assaying 53% in zinc. Recovery was 93.7%. Estimated amount of zinc in concentrates was 15,158,000 lb. No. 3 Shaft will be made ready for operation as soon as machinery arrives and is installed. About 500 ft. more work required to complete No. 2 shaft.

ANACONDA (Butte)—November production 25,500,000 lb. copper as against 31,500,000 lb.; decline chiefly due to severe cold spell early in November; total copper production for 11 months is about 307,900,000 lb. Company is defendant in suit brought by James A. Murray, who is endeavoring to establish title to the Iduna claim in the Kemper Addition to the City of Butte. Many mines closed two shifts Dec. 9, owing to shortage of railroad cars.

NEVADA

Elko County

LONG HIKE (Jarbidge)—E. A. Austin has taken charge of this group, reported under option through San Franciscans to the Guggenheims. Development reported to be highly satisfactory.

Esmeralda County

RED HILL FLORENCE MINING CO. (Goldfield)—Recently organized to merge and rehabilitate the Red Hill and Florence-American companies. Capitalization 2,500,000 shares, assessable. Adjoins Florence on the south.

FLORENCE (Goldfield)—As a result of friendly suit instituted by local creditor, Superintendent Clapp was appointed receiver. President Parker now in the East perfecting plans for refinancing. Future plans include sinking main shaft to shale with lateral development at that horizon.

Lyon County

BLUESTONE MINING AND SMELTING (Mason)—This Delamar property being reopened. A 1,200-ft. tramway and 2-mi. broad-gage spur will connect mine with the Copper Belt R.R.

Nye County

TONOPAH ORE PRODUCTION for week ended Dec. 2 was 9,747 tons, valued at $191,386, compared wtih 10,442 for week previous. Producers were: Tonopah Belmont, 2,937 tons; Tonopah Extension, 2,380; Tonopah Mining, 2,000; Jim Butler, 1,150; West End, 512; Rescue-Eula, 256; Halifax, 161; McNamara, 54; North Star, 53; miscellaneous, 244 tons.

CASH BOY (Tonopah)—As result of sinking in shaft of neighboring property, water is receding in winze from lower level; development to be resumed there.

LOUISIANA CONSOLIDATED (Tonopah and 120 Broadway, New York)—Has acquired the old Tybo lead and zinc mine near Reveille. Considerable ore between 300 and 400 levels. Shaft to be sunk 400 ft. Will install transmission line, electric hoist, compressor and drills. Walter E. Trent, president.

TEXAS

SULPHUR OPERATIONS are regarded as a possible outcome of the recent visit to Big Hill, Matagorda, by leading stockholders of the Gulf Sulphur Co. and other interests.

UTAH

Beaver County

WHITE CRYSTALS (Milford)—Car of ore ready for shipment.

ANTELOPE STAR (Milford)—East tunnel showing improvement; ore lead-silver.

Juab County

EUREKA LILLY (Eureka)—Shaft down 810 ft.; iron coming in at bottom. Property adjoins Tintic Standard.

PLUTUS (Eureka)—At meeting in Provo, Dec. 8, Walter Fitch was elected president, Cecil Fitch vice-president, J. William Knight among directors. Control of Plutus acquired by Chief Consolidated. Place of business transferred from Provo to Salt Lake.

IRON BLOSSOM (Silver City)—Copper ore being developed on 1,200 level of north workings, and sinking from 1,300 in progress. Drift from south shaft on 1,700 is approximately 200 ft. from being directly under north shaft workings. When underneath these workings, raise will be driven to connect. Croscutting on 1,700 also to be done to reach copper-bearing fissure.

Salt Lake County

HAULAGE CONDITIONS from Alta and Little Cottonwood have improved since recent snowfall. Ore hauling by means of bob sleds is possible from now on, and shipments from the camp will be much increased over what has been possible since about Oct. 1. The South Hecla company has large tonnage accumulated ready for shipment, and lessees at the property also have ore ready. The Michigan-Utah, Albion and Alta Consolidated have accumulations of ore.

ALBION (Alta)—Drift from Quincy tunnel level continues in ore. Material running 5 to 7% copper being saved.

OHIO COPPER (Bingham)—Time allowed stockholders for depositing stock with $1 a share for reorganization expires Dec. 15; New York Trust Co., depositary, 25 Broad St., New York.

MICHIGAN-UTAH (Alta)—Company has followed ore for 400 ft. from Lavinia tunnel to Copper Prince tunnel. Ore up to 8 ft. thick, carrying silver, lead and copper opened in latter tunnel. Lessees also mining ore.

EMMA COPPER (Alta)—Crosscut from second level of the shaft below Bay City tunnel reported to have cut ore carrying lead and silver. Crosscut being run for ore cut by diamond drill holes has not reached point where ore is expected.

WOODLAWN (Salt Lake)—Property in Big Cottonwood Cañon installing electric hoist and compressor. Buildings completed and supplies laid in for winter. Power to be taken from transmission line, running to Alta Tunnel and Transportation Co. W. J. Lawrence, manager.

UTAH METAL AND TUNNEL (Bingham)—Mill being increased from 225 tons daily to 300 tons. Expected to be ready by Feb. 1. New 100-ton flotation plant—built to treat tailings from other mill—operating, and treating 60 tons daily. Report for nine months ended Oct. 1 shows gross value of ore mined, $1,262,752; other receipts, $37,161; total income of $1,299,913. Expenses were $732,167, leaving operating profit of $567,737. Dividend of $342,472 was paid Aug. 15.

WASATCH MINES (Alta)—New 5,000-ft. drainage and operating tunnel is in 800 ft., 500 ft. being in solid rock. First 300 ft. opencut work. Progress of about 10 ft. daily being made. Object is to unwater old Columbus Consolidated stopes, and develop property at depth. Large belt-driven compressor recently installed working well, and furnishing ample power. Company furnishes air to a number of Alta mines. Company's Flagstaff tunnel workings or 700 level being extended.

Summit County

COMSTOCK-CALIFORNIA (Park City)—Lessees at property in Thaynes Cañon making regular shipments.

KEYSTONE (Park City)—Sinking resumed and no further water troubles anticipated. Newton Dunyon, superintendent.

THREE KINGS (Park City)—Winze from 500 down 130 ft. Last 40 ft. in gray limestone. Some mineralization—lead and silver—encountered. In brownish shaly limestone at bottom of winze. Drifting to southwest to be started here.

Tooele County

COPPEROPOLIS (Wendover)—Fifty-ton shipment of 10% copper ore carrying some silver and gold made from this property in Deep Creek section. Controlled by the Bambergers, of Salt Lake City.

WASHINGTON

Stevens County

MAGNESITE DEPOSITS reported in Colville Valley, near the town of Valley. Julius Fisk farm and the old U. S. marble quarry reported sold, owing to magnesite discoveries.

SECURITY COPPER (Chewelah)—Crosscutting started Dec. 1 toward No. 4 vein from 500-ft. level; shaft now 550 ft. deep. L. K. Armstrong, manager.

LOON LAKE-BLUE BIRD COPPER MINING CO. (Loon Lake)—New incorporation to develop Blue Bird and Dupont claims adjoining Loon Lake Copper Co. Andrew Laidlaw, of Spokane, interested.

UNITED COPPER (Chewelah)—The 250-ton mill, now equipped with flotation department, is making satisfactory recovery. Company resumed dividend payments last month after suspension of four years. Sinking of two-compartment shaft from 1,000-ft. to 1,500-ft. level recently authorized, diamond drilling having shown the ore 400 ft. below present workings. Conrad Wolfle, manager.

WISCONSIN

Zinc-Lead District

WICKS (Mineral Point)—Producing high-grade concentrates at its new Linden property; also operating the Senator mine, at Mifflin, under sublease.

FRONTIER MINING (Galena, Ill.)—After battling extra-heavy water and lean ground for three years, company has opened important body of ore at Hird No. 2 shaft; another mill will be erected at Bull Moose No. 2.

CANADA

British Columbia

SMELTERY AT LADYSMITH, formerly owned by Tyee Copper Co., reported purchased by New York men and is to be enlarged. W. J. Watson, formerly manager, is going to Ladysmith to remodel and start the plant.

CROW-FLEDGING (Ainsworth)—The 1,400-ft. crosscut tunnel struck the vein; being drifted on both ways.

COPPER BUTTE (Golden)—A 130-ft. tunnel has been driven to the vein and two small shipments of copper-silver ore made to Trail smeltery. Force of 9 men working; 16 horses packing ore to railway. B. Gass, of Seattle, in charge.

Ontario

DOME (South Porcupine)—During November milled 37,900 tons yielding $177,000; average value $4.67; working cost $2.88 per ton.

WRIGHT-HARGRAVES (Kirkland Lake)—Rich oreshoot showing tellurides and free gold reported in shaft at depth of 25 ft.

NEWRAY (Porcupine)—Manager Charlebois reports that test pit on west side near Plenaurum mine, at depth of 21 ft., gave assays of $36 per ton.

SCHUMACHER (Schumacher)—Production in November $18,295; working costs including sinking of new shaft, about $15,000. Shaft sunk to 200-ft. level where station is being cut.

KENABEEK (Kenabeek)—Vein, found at depth of 63 ft. in main shaft, has widened to 18 in. and shows good silver content. Five other veins have been encountered.

REAMSBOTTOM-EDWARDS CLAIMS in Langmuir Township acquired by Mond Nickel Co., of Coniston. Claims show small veins of niccolite but principal value is said to be in platinum content.

NATIONAL MINES (Cobalt)—Shaft on the King Edward, now under lease to this company, sunk to the contact at depth of 1,170 ft. Crosscutting started in the diabase just above the contact.

HARGRAVES (Cobalt)—Comprehensive development to be undertaken by Toronto, New York and Boston interests, which recently acquired control; due to discoveries in the Kerr Lake adjoining.

McINTYRE (Porcupine)—Following are terms on which the McIntyre Extension and Jupiter will be taken over by the McIntyre: Price of the Extension is 294,000 shares of McIntyre, equivalent to one share for every 3¼ shares of McIntyre Extension outstanding other than already owned by the McIntyre. For the Jupiter the price is 316,298 shares of McIntyre, equal to one share for every three of the Jupiter exclusive of those now held by the McIntyre. Proposition will be submitted to McIntyre shareholders at meeting on Dec. 28. It is proposed to issue $1,000,000 of stock to complete purchase making a total capitalization of $4,000,000; 389,317 shares to be retained in treasury.

MEXICO

ESPERANZA (El Oro, Mex.)—Milled in October, 15,675 tons; operating profit, £13,615.

CANANEA CONSOLIDATED (Cananea, Son.)—November copper output 5,100,000 lb.; in October, 6,030,000 lb.

CHILE

CHILE (Chuquicamata)—November copper production reported at 4,098,000 lb.; October, 4,542,000 lb.

BRADEN (Rancagua)—Output in November, 4,419,000 lb. copper; October, 4,048,000 lb.

PERU

CERRO DE PASCO (Fundicion)—Copper output for November, 5,700,000 lb.; October production approximately 6,000,000 lb.

JAPAN

COTTRELL PATENTS for electrostatic precipitation in Japan sold by Dr. F. G. Cottrell to a syndicate of seven leading Japanese mining companies. Several plants being installed, including one at Ashio smeltery and at a cement works.

The Market Report

Metal Markets

NEW YORK—Dec. 13, 1916.

The markets had already become dull previous to Dec. 12. Lead was holding strong, but spelter was becoming increasingly weak. The German peace proposals on Dec. 12, and the accompanying slump in the stock market, produced a general shock which was felt in the metal business.

Copper, Tin, Lead and Zinc

Copper—Very little business was reported by producers, barring a few sales of round lots for delivery in the second half of 1917. This business was, however, sporadic and was taken at considerable discount from going prices. Early in the week a little business for second quarter of 1917, with some first quarter thrown in, was done at 33½c., r.t. Following that the market is quoted nominally at unchanged prices. The momentous news of Dec. 12 excited a good deal of concern without having much direct effect upon the market. This was but natural in view of the sold-out condition of the producers. The chief effect that was discernible was the offering of near-by copper at 34½c. Indirectly it was evident that those consumers who had decided to remain uncovered and take their chances were better assured of their position.

The action of the British government, Dec. 8, in taking complete control of the copper business in Great Britain is discussed in our editorial pages. On Dec. 11 we had news that business had ceased on the London Metal Exchange. The continuance of quotations, which are cabled over, has been rather mystifying in view of the other news. A possible explanation is that they are only nominal prices, but as to this we have not yet any exact information.

Copper Sheets—Base price for copper sheets remains at 42c. for hot rolled and 43 for cold rolled, as reported last week. Wire is on a base of 37c., f.o.b. mill.

Tin—This market was quiet and inclined to be a little weaker. At the beginning of the week spot was 43¾c., and futures, 54c.; at the close, the quotations were 42⅞ and 42c., respectively.

Lead—This market passed chiefly into the hands of speculators and dealers, producers being generally sold out for near-by supplies. Prices varied according to delivery offered, whether December, January or February. The volume of transactions during the week was manifestly small in view of the slight participation by the producers. There were some large inquiries in the market from the Orient and some smaller ones from South America. An interesting question is how much lead is in the hands of speculators. That there is a speculative position is rather indicated by the behavior of the market on Dec. 12, when it became decidedly unsettled, with sellers at 7¾c., whereas 8c. had previously been asked. The same condition prevailed on Dec. 13.

Spelter—The weakness in this metal continued, prices sliding off from day to day on free offerings to sell. Buyers were apathetic throughout. A few who had been showing some interest changed their minds on Dec. 12. First hands were more desirous of selling spelter than they had been in the previous week, bit although there was a decided increase of bearishness, no sellers became aggressive. At the close of the week, December and first-quarter spelter was freely offered at 11c., no difference as to delivery.

Zinc Sheets—The price of zinc sheets remains based on $21 per 100 lb., f.o.b. Peru, Ill., less 8% discount, as reported last week.

Other Metals

Quicksilver—Unchanged at $80, market steady. San Francisco reports by telegraph $78, demand fair.

Antimony—Market steady at 14¼@14½c., with fair business. January-February shipment from China quoted at 13@13½c., c.i.f., New York, duty unpaid.

Nickel—The price of nickel remains unchanged at 45@50c. per lb., electrolytic commanding a premium of 5c. per lb.

Aluminum—Quotations are at 64@65c. per lb. for No. 1 ingots at New York.

Gold, Silver and Platinum

NEW YORK—Dec. 6

Gold—Metal to the amount of $11,300,000 has been imported from Canada and deposited in assay office for account of J. P. Morgan & Co. This makes a total imported from all sources since January $559,300,000. The stock of gold coin and bullion in this country on Nov. 1, according to the report of the Secretary of the Treasury, was $2,700,136,976, an increase of $714,597,804 in sixteen months, and that the deposits in national banks Sept. 12, the date of the last bank call, were $11,362,341,000. The stock of gold is the largest that any country ever had.

Silver—Owing to limited offerings in the London market, and the large mintage requirements silver is showing an advancing tendency. Recent English advices by letter are to the effect that the India government finding difficulty in procuring silver on reasonable terms has planned to issue a very large sum in rupee paper.

Platinum—Market declined further, round lots being sold at $85 per oz. previous to Dec. 12. It is rather doubtful if that price could have been realized subsequently.

Palladium—Quoted at $70 per oz.

Zinc and Lead Ore Markets

Platteville, Wis., Dec. 9—Quotations for the district according to the following prices: Base price per 2,000-lb. ton for material assaying 60% zinc was $105@97 for premium ore, down to $95 for medium grades. Base price per 2,000-lb. ton for material assaying 80% lead was $90. Shipments for the week ended Dec. 9 were: 3,300 tons of zinc ore, 183 tons of lead ore, and 770 tons of sulphur ore. For the year to date the figures are: 125,417 tons of zinc ore, 4,371 tons of lead ore, and 30,423 tons of sulphur ore. Shipped during the week to separating plants, 4,169 tons of zinc ore.

Joplin, Mo., Dec. 9—Price quotations per 2,000 lb.: Blende, high, $102.35; 60% zinc, premium ore, $100; medium, $95@80; low, $85; calamine per ton 40% zinc, $62.50@55. Average selling price, all grades of zinc, $91.40 per ton.

Lead, high price, $100; base, $98@95: Average selling price, all grades of lead, $87.84 per ton.

Shipments of the week: Blende, 8,931 tons; calamine, 726 tons; lead, 1,766 tons. Value, all ore the week, $1,037,830; 49 weeks, $35,766,610.

Purchase of one carload of lead by the Empire Zinc Co. sent the base price up to $98 for ore grading 80% metal content.

Sellers of zinc undertook to advance the market to $110 base this week, but nearly half the support was removed by the light demand, the large shipment being a reflex of last week's heavy purchases. Indications tonight are for a stronger demand around $95@100 base prices. The restriction of output from lack of electric power was assumed by sellers sufficient grounds for a higher ore price, but it went down instead of up. The electric power company is installing an additional steam auxiliary plant, but there is little prospect of its completion before Feb. 1. In the meantime low water has reduced power current to a minimum and the breaking of the steam turbines has crippled the present auxiliary plant until a new equipment can be installed.

Other Ores

Tungsten Ore—Market continues active at $18 per unit. Largest producer in this country reported to have advanced its price to $20 per unit. Europe continues to take ferro-tungsten which is quoted at $2.50 per lb. tungsten contained.

Iron Trade Review

NEW YORK—Dec. 13

The November pig-iron production did not come up to the remarkable rate of October. The total was 3,311,811 tons, or 110,394 tons a day, against 3,508,849 tons in the 31 days of October, or 113,189 tons per day. This record, however, exceeds that of any other month of the year aside from October.

It seems improbable that any relief of pig-iron stringency is to be expected from increased output. On the other hand, several furnaces have been blown out after long and hard campaigns and it is probable that others will follow. On Dec. 1, there were 322 furnaces in blast, with capacity of 108,127 tons a day, against 325 furnaces Nov. 1, producing at the rate of 109,022 tons per day.

Taken as a whole, the pig-iron market is not quite so feverish as it was a week or two ago, but there is no great slackening of demand and prices hold or continue to advance. Some buyers are holding off, however, even in view of the prospect for increased prices later.

The scarcity of semi-finished material, particularly sheet bars, is becoming serious. Many sheet mills are compelled to shut down for a day or two every week on account of inability to obtain bars. Buyers of sheet are also embarrased. Prices seem to be advancing, and five cents per pound seems to be the minimum for No. 28 black, while galvanized is selling freely at from $6.50 to $7.10. Some of the sheet-bar buyers charge that the shortage of that material is due largely to the use of a large tonnage for manufacturing shells.

The South seems to have been cleaned up rather completely on early iron and this fact has reduced the selling for export, though the inquiries from that direction are as heavy as ever. The opinion is voiced in the trade that foreign buyers will now begin to draw more heavily upon Virginia and northern districts where more metal for near-by shipments is available.

The shortage of cars for all services continues and is a factor of considerable importance in the iron industry as well as all other industrial ac-

SILVER AND STERLING EXCHANGE

Dec.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Dec.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
7	4.7550	75⅛	36¼	11	4.7550	75½	36⅛
8	4.7550	75½	36 1/16	12	4.7544	76	36⅜
9	4.7550	75½	36	13	4.7550	76	36⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Dec.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	33		7.63	7.40	11⅛
7	@33⅛	43⅜	@7.75	@7.60	@11⅜
	*33		7.63	7.50	11⅛
8	@33⅛	43⅛	@7.75	@7.70	@11⅛
	*33		7.65	7.55	11⅛
9	@33⅛	43⅛	@7.95	@7.75	@11⅛
	*33		7.75	7.65	11⅛
11	@33⅛	43⅛	@8.00	@7.80	@11⅛
	*33		7.63	7.50	10⅞
12	@33⅛	43	@7.75	@7.63	@11⅛
	*33		7.63	7.50	10⅞
13	@33⅛	42⅞	@7.75	@7.63	@11⅛

*Nominal.

The above quotations are our appraisal of the average of the major market based on sales as made and reported by producers and agencies; and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Dec.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
7	152	143	170	186½	188½	30½	58
8	151	142½	171	185½	187½	30½	58
9	....	....	....	....	....	....	....
11	148	....	168	185	186½	30½	58
12	145½	139½	168	184½	186½	30½	57
13	142½	136½	164	184½	186	30½	57

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½ cents.

tivities. It has gone so far, in fact, that many of the large automobile factories are considering a suspension of manufacturing simply because they cannot get cars to distribute the products. It is said that there are automobiles valued at about ten million dollars stored in Detroit alone at this time, waiting an opportunity for shipment. The car service also affects Canada, many of the firms there not being able to secure rolling stock to move their products.

PITTSBURGH—Dec. 12

The transportation situation is the center of interest in the iron and steel trades, everything else being subsidiary. Germany's proposal of peace is considered interesting, but merely an incident. Car shortages have daily grown more pronounced, and finished material is accumulating at mills at a more rapid rate. At the Homestead Steel Works there is about 50,000 tons stocked, some of it rolled as early as last September, and all of it desired by customers. At other works there are smaller, but still important, tonnages stocked, chiefly bars, small shapes and plates. The mills were not designed to carry such stocks, and the limit will soon be reached, mills having to slow down because they can pile no more. The curtailment may be forced at another point, however, as blast furnaces are already short of coke and have lost some production this month. Transportation conditions are practically certain to grow worse, as real winter weather, the first of the season, is promised tonight. The Pennsylvania system has practically embargoed all freight, except coal and coke, destined to move through Pittsburgh east or west. The Erie R.R. has declared an embargo against the Pittsburgh & Lake Erie, which itself is in fair shape except as to some divisions in the coke region.

The Steel Corporation's record gain in November in unfilled tonnage, 1,400,282 tons, was caused chiefly by the following influences: Placing of the bulk of the sheet and tinplate contracts for the first half of 1917, buying of tubular goods at almost double the shipping rates, heavy buying of car material, orders for ship plates, buying of rails for 1918 and buying of shell steel for the second half of 1917. Relatively little of this business continues this month, and a small gain in unfilled tonnage, possibly even a loss, is to be expected for December.

Steel prices show a hardening tendency but have progressed farther into the nominal stage as the mills are accepting less and less business on open contracts, while in the case of steel for specific jobs the delivery influences the price. Railroad spikes have advanced sharply in the past fortnight, from 2.65c. to 3.40c. Black sheets are up $5 a ton to 4.50c. minimum, with 5c. obtained on several prompt lots, while galvanized are up to 6.25@6.50c.

Pig Iron—The rapid pace of price advancing has halted somewhat in the past week. About three weeks ago an excited buyer paid $30, valley, for a large block of basic for second half, when sales had been made shortly before at $25 for first half and $30 was then regarded by sellers as the established market, but in the past week a conservative buyer has been able to pick up 10,000 tons at a shade under $30, valley, some of it being at $29. Bessemer, however, has sold in some instances at $36, though $35 has not entirely disappeared. Foundry is strong, sales being often made at $31, while $30 is rather unusual and $32 is claimed to have been done. We quote: Bessemer, $35@37; basic, $30; foundry and malleable, $30@32; forge, $29@30, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Steel—Ordinary soft-steel billets can be sold for export at $55, Pittsburgh, but hardly at $60. It is claimed there are only limited offerings even at $60. Prompt sheet bars have brought $60@62 but there is no market for forward and consumers will have to depend on tonnages due them on long term contracts. Rods are $65@75 for soft and $85@90 for carbon.

Coke

Connellsville—After softening to $7.50 or possibly $7.25 the middle of last week spot furnace coke stiffened and brought $8 on Saturday, while yesterday and today sales could readily be made at $8 and $8.25 was obtained in several instances, with $8.50 reported as done. Car supplies were better last week than for two weeks preceding but are poor this week and still higher prices are expected before the end of the week. An inquiry for about 10,000 tons a month during 1917 appeared this morning, but sellers are reserved about quoting. Some are disposed to name $4 to $4.50 for first half and about $5 for second half. Foundry coke is unchanged. We quote: Spot furnace, $8@8.50; contract, $4@5; spot foundry, $9@10; contract, $5.50@6.50, per net ton at ovens.

"Car supply started off bravely this week on an 80% distribution, but dropped to 60% on both Tuesday and yesterday, indicating that the average for the week will not be up to last.

Ferroalloys

Ferromanganese—The market is firmer and somewhat more active, prompt usually bringing $165. Contract remains at $164 for imported and $165 for domestic.

STOCK QUOTATIONS

N. Y. EXCH.†	Dec. 12
Alaska Gold M.	12
Alaska Juneau	7⅛
Am. Sm. & Ref., com.	108
Am. Sm. & Ref., pf.	114
Am. Sm. Sec., pf. A	97
Am. Sm. Sec., pf. B	92
Am. Zinc	50
Am. Zinc, pf.	75
Anaconda	87⅛
Batopilas Min.	1¼
Bethlehem Steel	575
Bethlehem Steel, pf.	145
Butte & Superior	65½
Chile Cop.	23⅛
Chino	61⅛
Colo. Fuel & Iron	49⅛
Crucible Steel	75⅛
Dome Mines	20½
Federal M. & S.	16
Federal M. & S., pf.	41½
Great Nor., ore ctf.	39½
Greene Cananea	48
Homestake	132
Inspiration Con.	62⅛
International Nickel	43⅛
Kennecott	51⅛
Lackawanna Steel	97
Miami Copper	41½
Nat'l Lead, com.	62½
National Lead, pf.	112
Nev. Consol.	28⅛
Ontario Min.	6
Quicksilver	2½
Quicksilver, pf.	2
Ray Con.	29⅛
Republic I. & S., com.	80⅛
Republic I. & S. pf.	113
Sloss-Sheffield	73
Tennessee Copper	‡24½
U. S. Steel, com.	118
U. S. Steel, pf.	121⅛
Utah Copper	113⅞
Va. Iron C. & C.	‡62

N. Y. CURB†	Dec. 12
Buffalo Mines	1.10
Butte & N. Y.	1⅛
Butte C. & Z.	13⅛
Caledonia	.51
Can. Cop. Corpn.	2
Cashboy	.06
Cerro de Pasco	39
Con. Ariz. Sm.	2
Con. Coppermines	3⅛
Con. Nev.-Utah	‡.25
Crystal Cop.	.87½
First Nat. Cop.	4
Florence	.76
Goldfield Con.	.63
Goldfield Merger	.07
Granite	.50
Hecla Min.	7⅛
Howe Sound	7⅛
Jerome Verde	1⅛
Joplin Ore & Spel.	.40
Kerr Lake	5
Magma	42½
Majestic	.87½
McKinley-Dar-Sa.	.57
Mother Lode	.44
Nevada Hills	.21
N. Y. & Hond.	17
Nipissing Mines	9
Oro	‡.03½
Ray Hercules	4⅛
Rochester Mines	7¼
St. Joseph Lead	17⅛
Standard S. L.	1⅛
Stewart	.31½
Success	.46
Tonopah	5
Tonopah Ex.	4⅛
Tribullion	.31½
Troy Arizona	.63
United Zinc	5⅛
White Knob, pf.	2½
White Oaks	4
Yukon Gold	2½

SAN FRAN.*	Dec. 12
Alta	.03
Andes	.18
Best & Belcher	.06
Bullion	.02
Caledonia	.25
Challenge Con.	.05
Confidence	.13
Cons. Imperial	‡.01
Con. Virginia	.13
Gould & Curry	.03
Hale & Norcross	.11
Jacket-Cr. Pt.	.03
Mexican	.20
Occidental	.65
Ophir	.14
Overman	.03
Savage	‡.08
Seg Belcher	.02
Sierra Nevada	.20
Union Con.	.50
Utah Con.	.02
Belmont	4.90
Jim Butler	.85
Mac Namara	.06
Midway	.20
Mont.-Tonopah	.18
North Star	.13
Rescue Eula	.28
West End Con.	.70
Atlanta	.10
Boston	.11
C. C. D. Con	‡.02
Comb. Frac.	.05
D'field B.B.	.05
D'field Daisy	.06
Jumbo Extension	.30
Round Mountain	‡.37
Sandstorm Kendall	‡.04
Silver Pick	.27
Argo	.06
Ariz. Central	.08
Big Jim	1.12½
Lazy Boy	.07
Nellie	.30
Tom Reed	1.85
United Eastern	4.50
United Western	.04

BOSTON EXCH.*	Dec. 12
Adventure	4½
Ahmeek	114½
Algomah	‡1½
Alloues	.71
Ariz. Com., ctfs.	14½
Bonanza	.40
Butte-Ballaklava	2⅛
Calumet & Ariz.	83
Calumet & Hecla	570
Centennial	.22
Copper Range	.70
Daly West	3
East Butte	16½
Franklin	9½
Granby	‡107
Hancock	17½
Hedley	.21
Helvetia	‡.75
Indiana	‡4½
Island Cr'k, com.	66
Isle Royale	36
Keweenaw	5½
Lake	13½
La Salle	‡5½
Mason Valley	6
Mass	15½
Mayflower	3
Michigan	3½
Mohawk	100
New Arcadian	5½
New Idria	15½
North Butte	24
North Lake	2½
Ojibway	2½
Old Colony	2½
Old Dominion	74½
Osceola	92
Quincy	95½
St. Mary's M. L.	95
Santa Fe	2
Shannon	9
Shattuck-Ariz.	31
So. Lake	6
So. Utah	.40
Superior	14½
Superior & Bost.	6½
Tamarack	43½
Trinity	6½
Tuolumne	1½
U. S. Smelting	70
U. S. Smelt'g, pf.	52
Utah Apex	3½
Utah Con.	18
Utah Metal	6½
Victoria	6½
Winona	5
Wolverine	49½
Wyandot	2

BOSTON CURB*	Dec. 12
Alaska Mines Corp.	.90
Bingham Mines	9½
Boston Ely	.65
Boston & Mont.	.68
Butte & Lon'n Dev.	.56
Calaveras	5½
Calumet-Corbin	.01½
Chief Con.	2½
Cortez	.25
Crown Reserve	.40
Davis-Daly	‡6⅛
Eagle & Blue Bell	1½
Houghton Copper	1½
Iron Cap Cop., pf.	19½
Mexican Metals	.45
Mines of America	2
Mojave Tungsten	2
Nat. Zinc & Lead	.61
Nevada-Douglas	1½
New Baltic	3
New Cornelia	17½
Ohio Copper	1½
Oneco	.86
Rex Cons.	.50
Rilla	.06
United Verde Ext.	39

SALT LAKE*	Dec. 12
Big Four	1.10
Black Jack	.05
Cardiff	7.25
Colorado Mining	.16½
Crown Point	.05
Daly-Judge	8.00
Emma Cop.	2.50
Empire Copper	1.50
Gold Chain	.17
Grand Central	.59
Iron Blossom	1.35
Lower Mammoth	.06½
May Day	.10½
Opohongo	‡.01
Prince Con.	1.32½
Seven Troughs	‡.03
Silver-King Coal'n.	3.30
Silver King Con.	4.55
Sioux Con.	.12½
So. Hecla	1.30
Uncle Sam	.06
Wilbert	.09
Yankee	.20

TORONTO*	Dec. 12
Bailey	.08
Beaver Con.	.45
Chambers Ferland	.17
Coniagas	5.50
La Rose	.56
Peterson Lake	.18
Right of Way	.08
Seneca Superior	‡.09
T. & Hudson Bay	72.00
Temiskaming	.63
Wettlaufer-Lor.	.10½
Dome Exten.	.26
Dome Lake	.62
Foley O'Brien	.70
Hollinger	6.85
Jupiter	.30
McIntyre	1.83
Newray	1.29
Porcu. Crown	.68
Vipond	.50
West Dome	.34

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Dec. 12
Cresson Con.	7.70
Doctor Jack Pot.	.10½
Elkton Con.	.12
El Paso	.41
Findlay	.06½
Gold Sovereign	.06½
Golden Cycle	2.58½
Granite	.62
Isabella	.22½
Jerry	.27
Portland	2.00
Vindicator	1.25

LONDON	Nov. 30
Alaska Mexican	£0 12s 6d
Alaska Tre'dwell	2 15 0
Burma Corp.	3 10 0
Cam & Motor	0 10 6
Camp Bird	0 6 6
El Oro	0 7 6
Esperanza	0 10 0
Mexico Mines	3 12 6
Nechi, pfd.	0 12 0
Oroville	0 16 0
Santa Gertrudis	0 9 6
Tomboy	1 1 3

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	68.515	24.240	23.591	32.584
October	50.654	49.385	67.855	23.199	23.925	32.361
November	49.082	51.714	71.604	22.703	25.094	34.192
Dec.	49.375	54.971		22.900	26.373	
Year	54.811	49.684		25.314	23.675	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	26.855	68.915	113.905	85.250	134.071
Oct.	17.686	27.193	72.601	122.750	88.000	142.523
Nov.	18.627	30.625	77.744	134.659	93.273	155.432
Dec.	20.133		80.773		100.430	
Year	17.275		72.532			

Tin	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	38.830	152.625	171.345
October	33.080	41.241	151.554	179.307
November	39.224	44.109	167.670	186.932
December	38.779		167.000	
Av. year	38.590		163.960	

Lead	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.483	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	6.810	4.490	6.699	23.151	30.786
October	4.600	7.000	4.499	6.898	23.994	30.716
November	5.155	7.042	5.078	6.945	26.278	30.500
December	5.355		5.266		28.807	
Year	4.673		4.567		22.917	

Spelter	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11.582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	8.990	13.270	8.820	67.841	52.095
Oct.	12.800	9.829	12.596	9.659	66.536	54.159
Nov.	15.962	11.592	15.792	11.422	88.409	56.023
Dec.	15.391		15.221		89.400	
Year	13.230		13.054		67.553	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic†		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.93	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.25
September	16.86	22.88	15.95	19.58	15.70	19.53
October	16.95	24.61	15.96	21.26	15.80	21.51
Novemoer	17.57	29.12	16.47	27.23	17.20	25.60
December	19.97		18.44		18.95	
Year	$15.82		$14.76		$14.95	

‡ As reported by W. P. Snyder & Co.

Mining Companies—United States

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Acacia, g	Colo.	1,438,989	$ 1	$ 122,004	Jan. '11	$0.01
Ahmeek, c	Mich.	200,000	25	5,750,000	Oct. '16	4.00
Alaska Mexican, g	Alas.	180,000	5	3,507,381	Nov. '15	0.10
Alaska Treadwell, g	Alas.	200,000	25	15,785,000	May '16	0.50
Alaska United, g	Alas.	180,200	5	2,045,270	Feb. '16	0.30
Alloues, c	Mich.	100,000	25	800,000	Oct. '16	2.50
Am. Sm. & Ref., com	U. S.	501,080	100	31,337,653	Sept. '16	1.50
Am. Sm. & Ref., pf	U. S.	500,000	100	57,431,386	Sept. '16	1.75
Am. Smelters, pf. A	U. S.	166,498	100	11,683,535	Oct. '16	1.50
Am. Smelters, pf. B	U. S.	300,000	100	17,010,000	Oct. '16	1.25
Am. Zinc, Lead & Sm	U. S.	228,120	25	1,108,820	Apr. '13	0.50
Anaconda, c	Mont.	2,331,250	50	115,891,875	Nov. '16	2.00
Argonaut, g	Calif.	200,000	5	1,760,000	Sept. '16	0.10
Arizona Copper, com	Ariz.	1,519,896	1.20	18,470,646	July '16	0.36
Arizona Copper "A," pf	Ariz.	160,000	1.20	247,795	Apr. '16	
Arizona Copper, pf	Ariz.	1,266,120	1.20	1,994,720	Nov. '16	
Baltic, c	Mich.	100,000	25	7,950,000	Dec. '13	2.00
Barnes-King, c	Mont.	400,000	5	60,000	June '16	0.075
Bingham N. H., c	Utah.	228,689	5	960,493	Dec. '15	0.05
Bonanza Dev., g	Colo.	300,000	1	1,425,000	Oct. '11	0.20
Brunswick, g	Calif.	395,287	1	203,315	Sept. '15	0.06
Bunker Hill Con., g	Calif.	200,000	1	876,000	Nov. '16	0.02½
Bunker Hill & Sul., l.s	Ida.	327,000	10	18,326,250	Nov. '16	0.50
Butte-Alex Scott, c	Mont.	79,311	10	1,054,119	Apr. '16	10.50
Butte-Ballaklava, c	Mont.	250,000	10	125,000	Aug. '10	0.50
Butte & Superior, z	Mont.	290,197	10	13,196,755	Sept. '16	6.25
Caledonia, l.s.c	Ida.	2,605,000	1	1,716,331	Nov. '16	0.03
Calumet & Arizona, c	Ariz.	641,602	10	26,949,457	Sept. '16	2.00
Calumet & Hecla, c	Mich.	100,000	25	134,250,000	Sept. '16	20.00
Camp Bird, g.s	Colo.	1,100,051	5	10,917,116	July '16	0.17
Cardiff, l.z	Utah.	500,000	1	375,000	Sept. '16	0.25
Centen'l-Eur., l.s.g.c	Utah.	100,000	5	4,150,000	Apr. '16	1.00
Center Creek, l.z	Mo.	100,000	10	595,000	July '16	0.15
Champion, c	Mich.	100,000	25	17,320,000	Nov. '16	6.40
Chief Consolidated, s.g.l	Utah.	880,676	1	527,518	Nov. '16	0.05
Chino, c	New Mex.	869,980	5	11,700,380	Sept. '16	2.25
Cliff, g	Utah.	300,000	1	90,000	Jan. '13	0.10
Cliff, g	Alas.	100,000	1	210,000	Oct. '13	0.01
Colo. Gold Dredging	Colo.	100,000	10	775,000	Feb. '16	1.00
Colorado, l.s.g	Utah.	1,000,000	0.20	2,570,000	Dec. '12	0.03
Commercial Gold	Ore.	1,666,000	1	230,490	May '16	0.00½
Cons. Inter. Callahan l.z	Ida.	464,990	10	4,649,900	Sept. '16	1.50
Continental, z.l	Mo.	22,000	25	583,000	July '16	1.00
Copper Range, c	Mich.	394,001	25	17,729,756	Sept. '16	2.50
Cresson Con	Colo.	1,220,000	1	3,916,163	Nov. '16	0.10
Daly West, s.l	Utah.	180,000	20	6,606,000	Jan. '13	0.15
Doctor Jackpot, g	Colo.	3,000,000	0.10	113,255	Oct. '16	0.01
Doe Run, l	Mo.	65,749	100	3,550,969	Dec. '13	0.76
Eagle & Blue Bell, g.s.l	Utah.	893,146	1	491,230	July '16	0.05
Elkton Con., g	Colo.	2,500,000	1	3,579,460	May '15	0.02
El Paso, g	Colo.	490,000	5	1,707,545	Feb. '14	0.10
Ernestine, g.s	N.M.	300,000	5	150,000	July '15	0.10
Fed. M. & S., com	Idaho.	60,000	100	2,708,750	Jan. '09	1.50
Fed. M. & S., pf	Idaho.	120,000	100	12,936,795	Sept. '16	1.00
Florence, g	Nev.	1,050,000	1	840,000	Apr. '11	0.10
Fremont Con., g	Calif.	200,000	2.50	258,000	Oct. '14	0.02
Frontier, s	Wis.	1,250	100	146,202	Nov. '13	2.00
Gemini-Key'ne, l.g.s	Utah.	5,000	100	2,330,000	June '16	5.00
General Dev	U. S.	120,000	25	3,503,917	Sept. '16	1.50
Gold Chain, g	Utah	1,000,000	1	130,000	May '13	0.03
Gold Dollar Con	Colo.	2,500,000	0.10	100,000	Dec. '12	0.00½
Gold King Con., g	Colo.	1,000,000	1	1,417,319	Nov. '15	0.01
Golden Cycle, g	Colo.	1,500,000	1	7,638,300	Nov. '16	0.02
Golden Star, g	Ariz.	400,000	5	140,000	Mar. '10	0.05
Goldfield Con., g	Nev.	3,559,148	10	28,999,832	Oct. '15	0.10
Good Springs Anchor, s	Nev.	550,000	1	108,785	May '16	0.01
Grand Central, g	Utah.	500,000	1	1,653,250	Oct. '16	0.04
Granite, g	Colo.	1,650,000	1	286,500	Dec. '12	0.01
Hazel, g	Cal.	900,000	1	971,000	Dec. '13	0.01
Hecla, l.s	Idaho.	1,000,000	0.25	5,155,000	Nov. '16	0.15
Hercules, l.s	Idaho.	1,000,000	1	12,600,500	Sept. '16	0.30
Homestake, g	S. D.	251,160	100	40,687,702	Nov. '16	0.65
Horn Silver, l.s.z	Utah.	400,000	25	5,682,000	June '16	0.05
Inspiration, c	Ariz.	1,181,967	20	6,184,117	Oct. '16	2.00
Inter'l Nickel, com	U. S.	1,673,384	25	33,451,414	Sept. '16	1.50
Inter'l Nickel, pfd	U. S.	89,126	100	5,882,102	Nov. '16	1.50
Iowa, g.s.l	Colo.	1,666,667	1	270,167	Dec. '15	0.00½
Iowa-Tiger, g.s	Colo.	3,000	1	25,179	Dec. '15	1.00
Iron Blossom, s.l.g	Utah.	1,000,000	0.10	2,850,000	Nov. '16	0.10
Iron Silver, s.l.g	Colo.	500,000	20	4,950,000	Dec. '14	0.10
Jamison, g	Cal.	390,000	10	386,100	Dec. '15	0.01
Jerry Johnson, g	Colo.	2,500,000	0.10	187,500	Nov. '14	0.01
Jim Butler-Toncpah, g.s	Nev.	1,718,021	1	515,406	Aug. '16	0.10
Judge M. & S., s.l	Utah.	480,000	1	1,470,000	Oct. '16	0.25
Jumbo Extension, g	Nev.	1,550,000	1	685,000	June '16	0.05
Kendall, g	Mont.	500,000	5	1,555,000	Apr. '16	0.10
Kennecott Cop., c	Alas.	2,780,583		11,121,848	Sept. '16	1.50
Kennedy, g	Cal.	100,000	100	1,831,001	Apr. '10	0.03
Klar Piquette, z.l	Wis.	20,000	1	259,000	Apr. '13	0.50
Knob Hill, g	Wash.	1,000,000	1	70,000	Oct. '13	0.00½
Liberty Bell, g	Colo.	133,551	5	1,752,795	Sept. '15	0.20
Little Bell, l.s	Utah.	300,000	1	90,000	Apr. '16	0.05
Magma, c	Ariz.	240,000	5	600,000	Sept. '16	0.50
Mammoth, g.s.c	Utah.	400,000	2.50	2,380,000	Sept. '16	0.05
Mary McKinney, g	Colo.	1,309,252	1	1,182,398	Oct. '16	0.01
May Day, g.s.l	Utah.	800,000	0.25	284,000	May '16	0.02
Mexican, g.s	Nev.	201,600	2.50	161,910	June '14	0.75
Miami, c	Ariz.	747,114	5	9,695,783	Nov. '16	1.50
Modoc, g.s	Colo.	500,000	1	275,000	Dec. '11	0.01
Mohawk, c	Mich.	100,000	25	5,575,000	Aug. '16	10.00
Monarch-Mad'a, g.s.l	Colo.	1,000,000	1	40,000	May '11	0.01
Montana-Tonop., s.g	Nev.	921,865	1	488,588	Dec. '12	0.10
Mountain, c	Cal.	250,000	25	4,216,250	May '08	0.44
National, g	Nev.	750,000	1	570,000	May '11	0.10
National Lead, com	N. Y.	206,554	100	9,655,216	Sept. '16	1.00
National Lead, pf	N. Y.	243,676	100	32,632,551	Sept. '16	1.75
Nevada Con., c	Nev.	1,999,457	5	24,474,937	Sept. '16	1.00
New Idria, q	Cal.	100,000	5	2,130,000	Oct. '16	1.00
North Butte, c	Mont.	430,000	15	13,567,000	Oct. '16	0.75
North Star, g	Cal.	250,000	10	4,962,040	Sept. '16	0.20
Old Dominion, (holding)	Ariz.	293,353	25	9,813,978	Sept. '16	3.00
Old Domin'n, M. & Sm	Ariz.	162,000	25	7,857,000	Sept. '16	3.00

Corrected to December 1, 1916.

Mining Companies—United States—(*Continued*)

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Ophir, s.g	Nev.	201,600	$3	2,068,360	Jan. '12	$0.10
Opohongo, g.s.l	Utah.	898,978	0.25	80,907	Jan. '13	0.02
Oroville Dredging	Cal.	686,538	5	2,107,215	Sept. '16	0.12
Osceola, c	Mich.	96,150	25	14,487,275	Oct. '16	5.00
Pacific Mines Corpn., g	Calif.	642,000	1	269,640	Nov. '16	0.01
Parrot, c	Mont.	229,850	10	7,871,839	July '15	1.63
Pearl Con., g	Wash.	1,909,711	0.05	181,422	Dec. '10	0.02
Pharmacist, g	Colo.	1,500,000	1	87,500	Feb. '10	0.00½
Phelps, Dodge & Co	U. S.	450,000	100	54,671,527	Sept. '16	8.00
Pioneer, g	Alas.	5,000,000	1	2,041,526	Oct. '11	0.03
Pittsburgh-Idaho, l	Ida.	809,407	1	252,483	Oct. '16	0.04½
Pittsburg Silver Peak, g	Nev.	2,790,000	1	771,200	July '14	0.02
Portland, g	Colo.	3,000,000	1	10,537,000	Oct. '16	0.03
Prince Con	Nev.	1,000,000	2	325,000	Oct. '16	0.02½
Quilp	Wash.	1,500,000	1	67,500	Feb. '12	0.01
Quincy, c	Mich.	110,000	25	22,987,500	Sept. '16	4.00
Ray, c	Ariz.	1,577,179	10	7,353,921	Sept. '16	0.75
Reorg. Booth, g	Nev.	1,000,000	1	500,000	July '16	0.10
Republic, g	Wash.	1,000,000	1	170,000	Nov. '12	0.01½
Rochester, l.z	Mo.	4,900	100	190,846	July '12	0.50
Round Mountain, g	Nev.	1,266,591	1	363,365	Aug. '13	0.04
Seven Troughs Coal., g	Nev.	1,443,077	1	246,419	Apr. '16	0.02½
St. Joseph, l	Mo.	1,409,466	10	12,029,681	Sept. '16	0.75
Shannon, c	Ariz.	300,000	10	900,000	Nov. '16	0.50
Shattuck Arizona, c	Ariz.	350,000	10	4,637,500	Oct. '16	1.25
Silver King Coalition, l.s.	Utah.	1,250,000	5	14,335,885	Oct. '16	0.15
Silver King Con., l.s.	Utah.	637,582	1	1,006,331	Oct. '16	0.10
Sioux Con., s.l.g	Utah.	745,389	1	872,097	July '11	0.04
Skidoo, g	Cal.	1,000,000	5	365,000	Oct. '14	0.01
Snowstorm, c.g	Ida.	1,500,000	1	1,192,103	Oct. '13	0.02
Socorro, g	N. M.	377,342	5	233,802	Sept. '16	0.05
South Eureka, g	Calif.	299,981	1	722,870	May '16	0.07
Standard Con., g.s	Cal.	178,394	10	5,274,407	Nov. '13	0.25
Stewart, s.l	Ida.	1,238,362	1	2,012,314	Dec. '15	0.05
Stratton's Ind., g	Colo.	1,000,000	0.60	618,625	Jan. '16	0.04
Success, z	Ida.	1,500,000	1	1,125,000	July '16	0.03
Superior & Pitts., c	Ariz.	1,499,792	10	10,318,569	Dec. '15	0.38
Tennessee, c	Tenn.	200,000	25	5,206,250	Apr. '16	0.75
Tomboy, g.s	Colo.	310,000	4.85	3,862,485	June '16	0.24
Tom Reed, g	Ariz.	909,555	1	2,528,648	Oct. '15	0.01
Tonopah Belm't, s.g	Nev.	1,500,000	1	8,393,035	Oct. '16	0.12½
Tonopah Ext., g.s	Nev.	1,272,801	1	1,591,747	Oct. '16	0.15
Tonopah of Nev., s.g	Nev.	1,000,000	1	13,600,000	Oct. '16	0.15
Trimountain, c	Mich.	100,000	25	1,450,000	Dec. '13	2.00
Tuoloumne, c	Mont.	2,500,000	1	520,000	May '13	0.10
Uncle Sam, g.s.l	Utah.	500,000	1	495,000	Sept. '11	0.05
United Cop. Min., c	Wash.	1,000,000	1	40,000	Nov. '12	0.01
United Globe, c	Ariz.	23,000	100	3,749,000	Sept. '16	18.00
U. S. Steel Corp., com	U. S.	5,083,025	100	246,504,807	Sept. '16	2.25
U. S. Steel Corp., pf	U. S.	3,602,811	100	420,732,690	Nov. '16	1.75
U. S. S., R. & M., com	U.S.-Mex.	351,115	50	7,679,024	Oct. '16	1.00
U. S. S., R. & M., pf	U.S.-Mex.	486,350	50	18,497,915	Oct. '16	0.87½
United Verde, c	Ariz.	300,000	100	39,997,000	Nov. '16	1.50
Utah, s.l	Utah.	100,000	10	281,860	Dec. '10	0.02
Utah, c	Utah.	1,624,490	10	46,530,062	Sept. '16	3.00
Utah Con., c	Utah.	300,000	5	9,825,000	Sept. '16	0.75
Valley View, g	Colo.	1,000,000	1	240,000	Dec. '10	0.04
Victoria, g.s.l	Utah.	250,000	1	207,500	Mar. '10	0.04
Vindicator Con., g	Colo.	1,500,000	1	3,532,500	Oct. '16	0.06
Wasp No. 2, g	S. D.	500,000	1	649,466	May '16	0.02½
Wellington Mines, g	Colo.	10,000,000	1	1,250,000	Oct. '16	0.02
Wolverine, c	Mich.	60,000	25	9,120,000	Oct. '16	6.00
Yak, s.l	Colo.	1,000,000	1	2,127,685	June '16	0.07
Yankee Con., g.s	Utah.	1,000,000	1	167,500	Jan. '13	0.01
Yellow Aster, g	Cal.	100,000	10	1,205,789	Nov. '16	0.05
Yellow Pine, l.z.s	Nev.	1,000,000	1	1,793,008	Nov. '16	0.10
Yukon Gold, g	Alas.	3,500,000	5	8,370,610	Sept. '16	0.07½

Canadian, Mexican and Central American Companies

Ajuchitlan, g.s	Mex.	50,000	$ 5	$ 212,500	Oct. '12	$0.25
Amparo, g.s	Mex.	2,000,000	1	2,060,883	Nov. '16	0.05
B. C. Copper	B. C.	591,709	5	615,399	Jan. '13	0.15
Beaver Con., s	Ont.	2,000,000	1	649,912	Apr. '16	0.03
Buffalo, s	Ont.	1,000,000	1	2,787,000	July '14	0.05
Canadian Goldfields, g	B. C.	600,000	0.10	290,000	July '14	0.001½
Chontalpan, g.s.l.z	Mex.	7,000	25	61,250	May '14	0.75
Cobalt Townsite, s	Ont.	45,000	1	1,042,259	May '14	0.10
Coniagas, s	Ont.	800,000	5	8,440,000	Nov. '16	0.25
Con. M. & S. Co. of Can.	B. C.	337,100	25	2,949,626	Oct. '16	2.50
Crown Reserve, s	Ont.	1,999,957	1	6,102,408	July '15	0.02
Dome Mines, s	Ont.	400,000	10	1,000,000	Sept. '16	0.50
Dos Estrellas, g.s	Mex.	300,000	0.50	10,335,000	Dec. '13	1.50
El Oro, g.s	Mex.	1,147,500	4.85	8,947,260	July '13	0.24
Esperanza, s.g	Mex.	455,000	4.85	12,013,882	July '15	0.24
Granby, s.l.c	B. C.	149,985	100	6,875,259	Nov. '16	2.00
Greene Cananea	Mex.	488,414	100	7,792,856	Nov. '16	2.00
Greene Con., c	Mex.	1,000,000	10	12,044,400	May '16	1.00
Guanajuato D., pf., s	Mex.	10,000	1000	214,356	Jan. '10	3.00
Hedley Gold	B. C.	120,000	10	2,003,520	Sept. '16	0.50
Hollinger, g	Ont.	4,800,000	5	6,090,000	Nov. '16	0.05
Kerr Lake, s	Ont.	600,000	5	6,570,000	Sept. '16	0.25
La Rose Con., s	Ont.	1,498,627	5	5,686,845	Oct. '16	0.05
Le Roi No. 2, g	B. C.	120,000	24.30	1,566,450	Mar. '16	0.30
Lucky Tiger Com., g	Mex.	715,337	10	3,649,673	Oct. '16	0.09
McK.-Dar. Sav. s	Ont.	2,247,692	1	4,810,056	Oct. '16	0.03
Mines Co. of Am. (new)	Mex.	862,658	10	4,958,600	July '13	0.12½
N. Y. & Hond. Ros., g	C. A.	200,000	10	4,190,000	Oct. '16	0.50
Nipissing, s	Ont.	1,200,000	5	14,940,000	Oct. '16	0.25
Penoles, s.l.g	Mex.	80,000	25	6,361,688	June '13	1.25
Pinguico, pf., s	Mex.	20,000	100	840,000	Oct. '13	3.00
Right of Way Mns., s	Ont.	1,685,500	1	569,042	Sept. '16	0.00½
Rio Plata, s	Mex.	374,518	5	345,745	Feb. '13	0.05
San Rafael, g.s	Mex.	2,400	25	1,442,380	Jan. '14	0.50
San Toy, g.s	Mex.	5,750,000	1	530,000	July '13	0.01
Seneca-Superior	Ont.	478,884	1	1,555,873	Oct. '16	0.20
Sorpresa, g.s	Mex.	19,200	20	3,979,240	Jan. '11	34.00
Stand'd Silver-Lead	B. C.	2,000,000	1	2,350,000	Nov. '16	0.02½
Temiskaming, s	Ont.	2,500,000	1	1,684,156	Nov. '16	0.03
Tem. & Hud. Bay, s	Ont.	7,761	1	1,940,250	Nov. '14	3.00
Trethewey, s	Ont.	1,000,000	1	1,061,998	July '14	0.05
Wettlaufer-Lorrain, s	Ont.	1,416,590	1	637,465	Oct. '13	0.05